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VITAMIN A AND D STUDIES WITH GROWING CHICKS

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This experiment was undertaken chiefly in view of the fact that various fish liver and fish body oils have been used in the past as a vitamin D or A supplement to poultry rations. Cod liver oil has long since been proven to be an efficient supplement and when of good quality supplies sufficient of vitamin A (growth producing) and D (anti-rachitic) for both growth and egg production. Detailed references in the literature upon the subject of cod liver oil feeding to poultry are numerous and cannot be referred to within the space of this paper. It is sufficient to say that its value has been determined for this purpose, the proper level of administration and the most suitable method of assaying its potency being the principal questions of controversy at the present time. A rather complete bibliography upon cod liver oil in animal feeding has been prepared by Manning (*1*).

Within the last few years attention has been directed to the study of fish and fish liver oils other than cod, and pilchard oil has come in for its share of investigational work as being a product produced in large quantities particularly upon the Pacific coast of this continent. Davis and Beach (*2*) found salmon oil to compare favourably with cod liver oil as a source of vitamin A. Bills (*3*), in rating various fish products according to comparative vitamin D content, rating cod liver oil as 100, gives sardine oil a similar rating as to quality. Maynard and Miller (*4*) found that Menhaden oil was a good source of vitamin D. Nelson and Manning (*5*) found pilchard oil to have a rating of 100 in comparison with the same rating for cod liver oil in vitamin D content. Asmundson, Allardyce and Biely (*6*) working with chickens, found pilchard oil to be inferior to cod liver oil for bone development. Brocklesby (*7*) found the vitamin D potency of dogfish liver oils to be from 10 - 30 per cent of that of medicinal cod liver oil and to vary greatly according to source. Brocklesby and Denstedt (*8*) found pilchard oil (British Columbia Coast) to be a potent source of vitamin D. All the above oils, with the exception of salmon and dogfish liver oils are from fish almost identical in nature to the Pilchard of the British Columbia Coast from which the samples herein used were obtained.

The various other agencies used in this test, such as the mercury vapour lamp for the production of ultra violet rays, and glass substitutes which permit of penetration of these rays (rather than filtering them out as is done by common glass) have also been used extensively

[1]Poultry Husbandman.

in the past at this Division (*9*) and at numerous other research establishments. Detailed reference to these will not be quoted in this paper for reasons of brevity.

Experimental

In the planning of this experiment it was hoped that the value of pilchard oil both for its vitamin A and vitamin D content might be measured under conditions closely comparable to those met with upon the average commercial poultry plant. Cross bred chickens, from White Leghorn males × Barred Rock females were used being separated at hatching time into groups containing only cockerels and pullets in the manner described by Warren (*10*). The experiment was made up of fourteen pens in all, seven of cockerels and an equal number of pullets, each pen chosen so that the greatest possible uniformity in weight and apparent condition was obtained between pens. The following represents the disposition of the various pens as to sex and treatment.

Cockerels.

Pen 1. Direct sunlight.
Pen 3. No sunlight or substitute.
Pen 5. No sunlight—Ultra Violet light (mercury vapour lamp) twenty minutes daily, at a distance of three feet from the subjects.
Pen 7. No sunlight—sunlight lamp (socket bulb) eleven hours daily.
Pen 9. Sunlight through "Vita Glass" only.
Pen 11. Sunlight through "Vioray" glass substitute only.
Pen 13. Sunlight through "Windowlite" glass substitute only.

Pullets.

Pen 2. Direct sunlight.
Pen 4. No sunlight—1 per cent Pilchard oil No. 2.
Pen 6. No sunlight—1 per cent Cod liver oil.
Pen 8. No sunlight—2 per cent Pilchard oil No. 1.
Pen 10. No sunlight—2 per cent Pilchard oil No. 2.
Pen 12. No sunlight—2 per cent Cod liver oil.
Pen 14. No sunlight—Pilchard oil No. 2 (white corn).

Where direct sunlight is referred to, the treatment consisted of permitting the direct rays of the sun to enter the pen through an open window. During the course of the experiment from April 10th to May 22nd, 1931 (6 weeks) sunlight entered the pens for a total of 226.5 hours or 6.47 hours daily on the average. Where treatment is indicated as no sunlight or substitute, all sunlight was excluded by placing heavy brown wrapping paper over the windows, daylight alone entering by north windows through glass. The sunlight lamp used was manufactured by a large electrical concern and was similar to an ordinary frosted light bulb in appearance. Of the glass substitutes mentioned the first two represent glasses of the quartz type and the other the wire screen type.

The pilchard oil used was of two qualities, No. 1 which represents pilchard oil extracted with the greatest care and handled in such a way as to insure the least possible destruction of vitamins, and No. 2 which represents the ordinary commercial run of oil as produced at canneries

upon the coast of British Columbia. The cod liver oil used was a Newfoundland poultry oil, which had been proved to be of high potency by previous work at this Division (*9*).

The following data give an indication of the comparative quality of the oils used as regards free fatty acid content and also with respect to their growth producing Vitamin A value as indicated by the colorimetric test (*11*).

Sample	Free fatty acids as oleic.	Vitamin A content
Pilchard oil No. 1	.60	Nil
Pilchard oil No. 2	.89	Nil
Cod liver oil	2.16	6 Lovibond blue units

(Analyses, courtesy of the Division of Chemistry of this Farm).

In comparing the pilchard oils it is noticeable that the fatty acid content is lower in the more refined oil and much lower in both than in the cod liver oil, which is a point in favour of the former oils. According to these data they are devoid of vitamin A whereas cod liver oil contains approximately the minimum which Drummond (*11*) cites as desirable in a cod liver oil for stock feeding purposes. It should be mentioned here that papers recently published by Coward *et al* (*12*) and Gillam and Morton (*13*) have cast serious doubt upon the value of the colorimetric test for vitamin A and are in agreement in the opinion that the colorimetric test as conducted "though it may act as a rough guide to vitamin A potency, is theoreticallly unsound".

In pen 14, white corn meal was substituted for the yellow corn meal of the mash in order to reduce the vitamin A content of the ration as much as possible, yellow corn being a good source of this vitamin.

With the exception only of pen 14, as noted above, the following all mash ration was given to all pens:—Shorts, Middlings, Yellow Corn Meal, and Ground Oat Groats 22 per cent of each; Meat Meal 6 per cent Fish Meal, Buttermilk Powder and Bone Meal 2 per cent of each. This mash showed an analysis as follows:—Water 10.57 per cent; Ash 5.95 per cent; Fibre 3.14 per cent; Protein 18.27 per cent; Carbohydrates 55.28 per cent; Fat 7.31 per cent.

Oyster shell was available *ad. lib.* but no green feed was given during the experiment. All oils used were incorporated into the mash for each pen at the time of mixing just prior to the commencement of the experiment.

Weighings of all pens were made weekly and mortality noted to actual date so that calculation of feed consumption could be made upon a bird day basis. All dead birds were autopsied in the pathological laboratory for cause of death.

At the close of the experiment two birds, representative of the pen in so far as could be judged by external characteristics, were removed from each pen, the tibia-fibula of the right limb of each dissected out and forwarded to the Division of Chemistry for ash analyses.

Data

Uniformity in condition and growth during the early stages of the experiment was excellent and mortality was practically nil. The accompanying charts show the growth attained by each pen, the gain each week and the efficiency of use of food which is calculated as the gain in body weight in proportion to the food consumed. The percentage ash in the tibia-fibula bones of the representative chicks selected is also shown in the charts. The pullet and cockerel pens are treated separately in charts 1 and 2 respectively since the comparison of different oils was confined to the pullets and of sunlight and its variations to the cockerels. It will be necessary in dealing with the pullet pens to use two cockerel pens, namely pens 1 and 3 on direct sunlight and without sunlight or substitute, respectively, as controls. In the case of the latter, it was not found possible to duplicate this pen with pullets and in the former case this pen must be substituted for the pullet pen upon direct sunlight, in so far as is possible, owing to the fact that the low temperature and resultant draughts experienced kept the pullets away from the windows and the sunlight during the first part of the experiment whereas the cockerels, owing to the nature of the ventilation of the building, were not under this handicap.

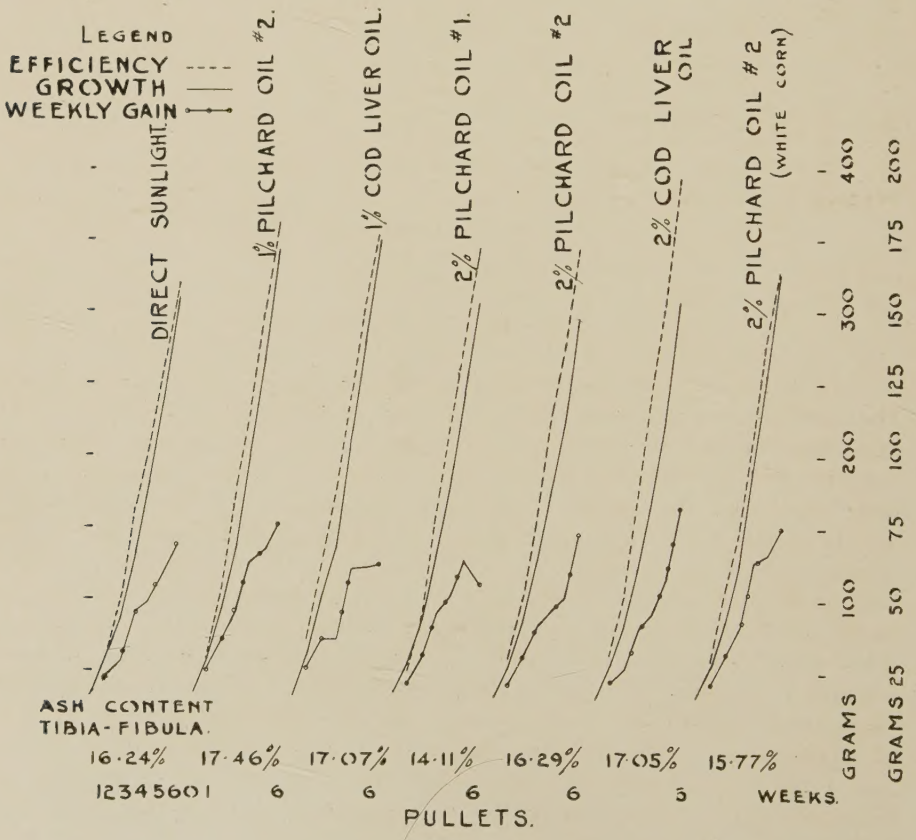
LEGEND
EFFICIENCY ----
GROWTH ——
WEEKLY GAIN
DIRECT SUNLIGHT
1% PILCHARD OIL #2.
1% COD LIVER OIL.
2% PILCHARD OIL #1.
2% PILCHARD OIL #2
2% COD LIVER OIL
2% PILCHARD OIL #2 (WHITE CORN)
ASH CONTENT TIBIA-FIBULA.
16·24% 17·46% 17·07% 14·11% 16·29% 17·05% 15·77%
1 2 3 4 5 6 0 1 6 6 6 6 5
WEEKS.
PULLETS.
GRAMS 100 200 300 400
GRAMS 25 50 75 100 125 150 175 200

Chart 1.

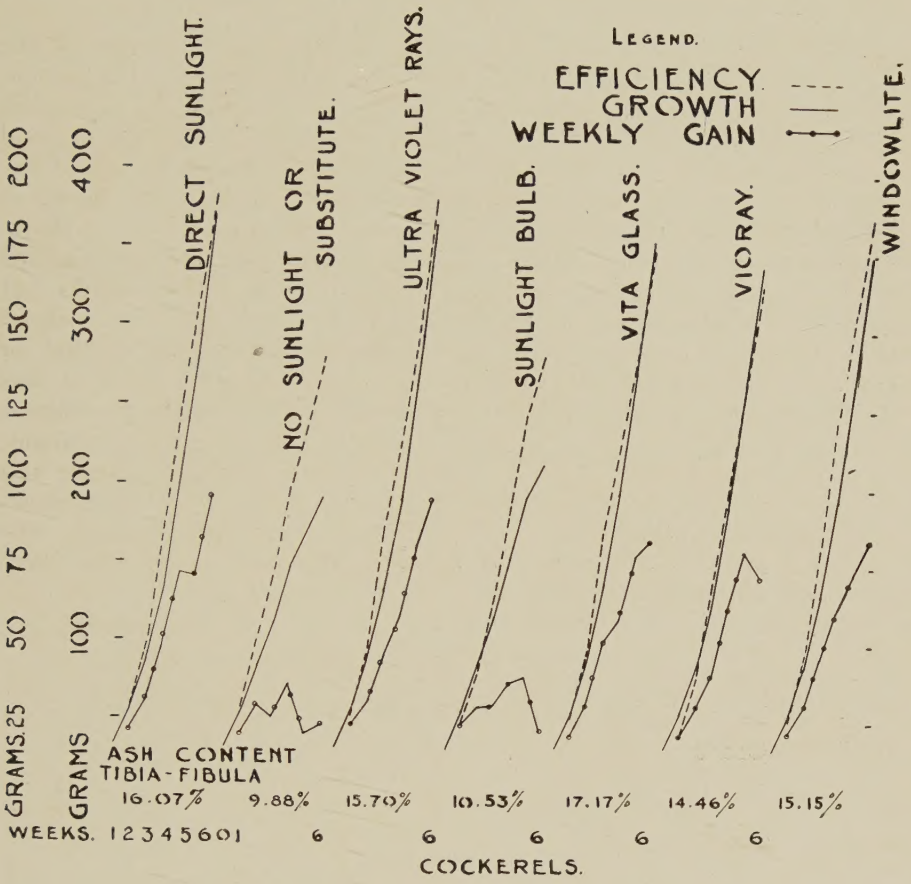

Chart 2.

Discussion

In considering the results from the pullet pens it will be noticed that the positive control upon direct sunlight must be eliminated from the consideration for reasons just mentioned. After making due allowance for the greater weight expected of cockerels the direct sunlight pen in that group may be compared to the pullet pens. Since figures from upwards of 800 birds covering a period of seven years indicate that pullet weight in White Leghorns is approximately 87.8 per cent of cockerel weight at eight weeks of age (*14*) it may be safely determined that a fairly similar condition would exist under the conditions of this experiment. This would give a weight closely comparable to the 1 per cent pilchard oil and 1 per cent cod liver oil pens among the pullets. It is apparent then, from the graphs submitted, that no significant difference in growth produced exists between direct sunlight, 1 per cent pilchard oil No. 2 and 1 per cent of cod liver oil. While the pens receiving 2 per cent of these oils did not attain so great a weight it is doubtful if the differences between any of these pens are in any way significant. In comparison

with the unsupplemented ration, the birds upon which received neither sunlight nor substitute (chart 2), all the additions to the rations of the pullet pens gave superior results. A feature of more than passing interest is the low consumption of feed for the gain obtained upon 2 per cent of cod liver oil as indicated by the efficiency curve for this pen.

Without doubt the most positive indication of the efficiency of these supplements, in so far as vitamin D is concerned, is the percentage ash content of the chick bones analysed. It will be noted from a consideration of the charts that in no instance is there a significant difference in the ash content of bones except for the pens with "no sunlight or substitute" and the "sunlight bulb". The proportionate ash content of the different pens is perhaps best illustrated by taking the highest ash content as 100 per cent (1 per cent pilchard oil No. 2 - 17.46 per cent ash) and calculating the remaining pens as percentages of that figure as follows:

Ash content of tibiae-fibulae taking the highest percentage as 100

Pullets	Percentage
Direct Sunlight	93.01
1 per cent Pilchard oil No. 2	100.00
1 per cent Cod liver oil	97.77
2 per cent Pilchard oil No. 1	80.81
2 per cent Pilchard oil No. 2	93.30
2 per cent Cod liver oil	97.65
2 per cent Pilchard oil No. 2 (white corn)	90.32
Cockerels	**Percentage**
Direct sunlight	92.04
No sunlight or substitute	55.59
Ultra Violet Rays	89.92
Sunlight bulb	60.30
Vita glass	98.34
Vioray	82.82
Windowlite	86.77

It is apparent from the above that in the case of the pullet pens there is no significant difference in the ash content of any pen with the possible exception of the 2 per cent of pilchard oil No. 1 pen showing only 80.81 per cent of the ash of the best pen. All pens are, however, significantly higher than the control pen "no sunlight or substitute" with only 56.59 per cent of the ash content of the best pen.

The same may be said of the cockerel pens the exception in this instance being the pen under treatment with the sunlight bulb and showing only 60.3 per cent of the ash of the best pen. It may be said in this connection that rickets was first experienced in the "no sunlight or substitute pen" at four weeks of age and at five weeks was very advanced and almost general throughout the pen. In the pen under the sunlight bulb treatment rickets was first evidenced at five weeks of age and was quite advanced at the end of the experiment. In comparing this pen to the control "no sunlight or substitute" pen, it is evident from growth, weekly gain, efficiency of use of feed and ash content of bone that this

treatment only slightly accelerated calcium deposition in bone formation and did not protect the pen against rickets. With the exception of this pen it may be said that all other treatments accorded both to pullets and cockerels prevented the occurrence of rickets and produced normal growth with no appreciably significant difference between the various treatments except in one or two cases where a difference of doubtful significance was obtained.

It is also apparent from the data that the extra care in refining which was given to the sample pilchard oil No. 1 had no beneficial effect upon its growth producing or ash depositing value but seemingly had the reverse effect. This observation is fully substantiated by previous research at this Division (*9*) which indicated crude cod liver oil to be more efficient than refined oil for poultry feeding.

Since this project was only of sufficient duration to ascertain whether prevention of rickets and normal growth would be obtained during the starter period, the pen upon 1 per cent of pilchard oil No. 2 was carried to sixteen weeks of age under the same treatment and in close confinement. Growth was entirely normal and the pullets were in excellent condition throughout.

In order to test the curatve effect of pilchard oil once a severe condition of rickets has been induced the rachitic birds from the "no sunlight or substitute" and "sunlight bulb" pens were segregated out and given mash containing 1 per cent of pilchard oil No. 2 for a period of ten days. When no improvement was evidenced at the end of this period a mash containing 2 per cent of the oil was given for a further period with practically no evidence of improvement. From this time on a wet mash only was given using the oil as a mixer which required a high percentage of oil. Ten days after feeding of this wet mash the birds were recovering rapidly.

Turning to a consideration of the vitamin A content of the mash it is apparent from chart 1 that the substitution of white corn meal containing no vitamin A for yellow corn meal which is a fair to good source of vitamin A did not significantly affect the growth, efficiency or bone ash of the birds. In view of the fact that the vitamin A test (colorimetric) had shown the complete absence of vitamin A from the pilchard oil as previously mentioned it was assumed that possibly some other ingredients of the mash contained sufficient of the vitamin to insure normal growth. Reference to the literature indicates clearly that where any considerable amount of liver tissue is incorporated into meat and fish meals they become a source of vitamin A and D providing that the rendering process has not been so severe as to destroy these vitamins. Also, buttermilk powder, when high in fat, may contain appreciable amounts of this vitamin. It is quite possible that a small amount of both vitamins A and D was present in these ingredients in this instance although the fact that the onset of rickets in the "no sunlight or substitute pen" took place at the normal period as determined by previous work here (*9*) would tend to militate against the possibility of there being any D present in these ingredients.

In order to check the possibility of the presence of vitamin A in the basal ration, two pens of Leghorn chicks were confined to batteries and

given the following all mash ration:—Bran 22 parts, middlings 28, ground oats 27, white corn meal 11, skim milk powder 12, and ½ per cent of common salt, and giving an analysis as follows:—Water 9.36 per cent; ash 4.11 per cent; fibre 2.12 per cent; protein 17.51 per cent; carbohydrates 59.39 per cent; fat 5.23 per cent. The possibility of there being any vitamin A in this mash is very remote indeed. One pen received this mash with no supplementary treatment except for exposure to ultra violet rays from a mercury vapour lamp for twenty minutes daily at a distance of three feet from the subjects, to ensure adequacy of the vitamin D equivalent. The other pen received 1 per cent of pilchard oil No. 2 in the mash. Chart 3 submitted herewith, shows the results obtained.

It will be noted that at three weeks of age the growth curves are interrupted. The interruption indicates the period at which the birds under ultra violet rays with no vitamin A containing supplement were so reduced in condition, and experienced such high mortality, that they had to be discontinued. All the chicks of this lot subsequently died. The chicks receiving pilchard oil were also very unthrifty but practically no mortality occurred. The curves show graphically the different rate at which the two lots were gaining up to this time.

Bone analyses from chicks of both pens showed abnormally low ash content, 5.74 per cent and 6.50 per cent respectively for the pens without and with pilchard oil. Previous work at this Division and elsewhere tends to indicate that when vitamin D is lacking in the ration growth is very

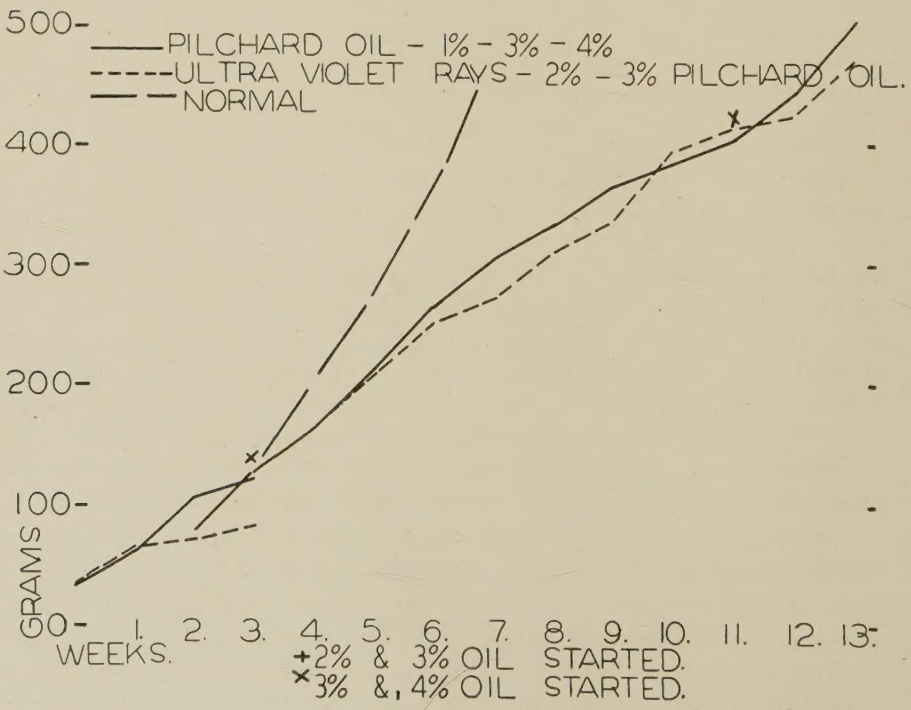

Chart 3.

greatly diminished even though vitamin A be present in large quantities. Conversely, where a deficiency of vitamin A exists it would appear that metabolism is interfered with to such an extent that calcification and bone development are seriously retarded. Such a condition undoubtedly existed in this instance. Since it was evident that 1 per cent of pilchard oil was not giving satisfactory growth and condition, this pen was divided evenly as to condition and weight, one lot being given 2 per cent and the other 3 per cent of oil. The birds quickly regained condition but continued to grow slowly as indicated by the curves. At a later period the oil was increased to 3 per cent and 4 per cent respectively and it would appear that possibly some response was obtained. When these curves are contrasted with the normal curve plotted from growth data for chicks receiving a complete ration and kept in the same battery during 1930 (*15*) (normal curve, chart 3) and which started on experiment at two weeks of age, having been previously held back, it is apparent that far from normal growth was obtained.

Whether this may be attributed to the low A content of the pilchard oil or not is a question since it cannot be estimated just what retarding effect these birds experienced during the first three weeks upon 1 per cent of oil. Our experience would indicate that in most conditions of deficiency birds recover rapidly when the deficient condition is remedied but never attain the same weight or development. If this observation is correct it is apparent that the pilchard oil even at 2 per cent and 3 per cent levels did not supply sufficient A. It can certainly be postulated, however, that 1 per cent of pilchard oil was not sufficient to produce good growth and did not prevent a deficiency condition from being evidenced when fed with a ration otherwise devoid of vitamin A. Evidence is lacking to demonstrate that 1 per cent of poultry cod liver oil, in conjunction with a ration otherwise completely devoid of vitamin A, would give completely normal growth in chicks, although all authorities agree that it is a good source of vitamin A. It is hoped to carry on work which will demonstrate this comparison at a later date. It would appear then that while pilchard oil, at a level of 1 per cent will produce normal growth with a ration such as the one outlined in the first part of this experiment containing 22 per cent of yellow or white corn meal, it fails entirely to produce normal growth in a ration completely devoid of vitamin A. The economic significance of this fact is mainly that it suggests that rations well fortified with vitamin A from other sources should be used where pilchard oil is fed as a vitamin supplement. Yellow corn meal, and particularly alfalfa leaf meal, are probably the most suitable ingredients of the mash for this purpose, while green clover and alfalfa make excellent fresh supplements.

Pilchard oil is evidently an excellent source of vitamin D since rickets was prevented in all cases in this experiment when fed at levels similar to those at which cod liver oil is ordinarily fed. It must be borne in mind, however, that no attempt was made to feed a ration completely deficient in vitamin D but merely one sufficiently low to induce rickets in the absence of sunlight or some substitute. The ration used has previously produced rickets at this Division (*9*) when unsupplemented. As a consequence,

where rations are fed which are known or suspected to be considerably more deficient in this vitamin than the ration used in this experiment, it is quite possible that a greater percentage of oil may be necessary.

Considering the glass substitutes used, all were efficient from the standpoint of prevention of rickets and the production of growth. No significant difference existed between various brands. The sunlight socket lamp, however, was inefficient in the production of ultra violet rays of the wave lengths necessary for the normal calcification of bone. As in the past (*9*) ultra violet rays from a mercury vapour lamp proved very efficient for this purpose.

In order to obtain confirmatory data the project was duplicated in part upon the Experimental Farm at Nappan, Nova Scotia, and the Experimental Station at La Ferme, Quebec, using the following pens:— Direct sunlight; 1 per cent pilchard oil No. 2; no sunlight or substitute; 1 per cent pilchard oil (white corn) and 1 per cent cod liver oil. Results obtained from these pens upon both Farms substantiate the findings above reported, in growth, condition, and bone analyses. Consequently the detail of these projects will not be reported herein but may be obtained from the Farm or Station concerned. It is sufficient to point out that the confirmation obtained under such varying conditions of climate adds appreciably to the value of the results obtained at Ottawa.

Summary

(1) It has been demonstrated that the addition of pilchard oil to the rations used in this experiment at the rate of 1 per cent of the total feed consumed prevented the occurrence of rickets and produced normal bone development. The pilchard oil and cod liver oil used were of equal efficiency in this test. It is concluded, therefore, that when pilchard oil similar in quality to that used herein is available it may be substituted for cod liver oil for this purpose.

(2) Pilchard oil failed to support normal growth at a level of 1 per cent, when fed with an otherwise A deficient ration. The response with additional quantities of the oil was doubtful. It is suggested that when pilchard oil is fed as a vitamin supplement, the ration should be otherwise well fortified with feeds high in vitamin A content.

(3) Carefully refined pilchard oil proved to be no more efficient in supplying vitamin D than the general run of oil.

(4) Direct sunlight, the mercury vapour lamp, pilchard oil, cod liver oil and certain glass substitutes appeared to be almost equally efficient in supplying the vitamin D factor or its equivalent.

(5) The sunlight socket lamp proved to be quite inefficient and failed to supply sufficient ultra violet rays to prevent severe rickets in chicks at five weeks of age.

Acknowledgments

The cooperation of the Division of Chemistry of the Central Experimental Farm, Ottawa, through the making of colorimetric tests and bone analyses, is gratefully acknowledged.

The writer also wishes to express his appreciation of the work of the Experimental Farm at Nappan, Nova Scotia, and the Experimental Station at La Ferme, Quebec, in carrying out a duplicate corroborative test of this experiment.

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A FIELD CLASSIFICATION OF SOILS FOR USE IN THE SOIL SURVEY[1]

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In recent years the importance of soil survey has become recognized in Canada. In the provinces of Alberta, Saskatchewan, Ontario, Manitoba, Quebec, and more recently, British Columbia, soil survey projects have been undertaken and soil mapping is in progress. Some of these surveys are undertaken as federal and provincial projects, some are conducted as provincial, and others as local projects; but, irrespective of the organization under which the work is being done, and notwithstanding the importance of each project locally, it is earnestly to be desired that a complete correlated soil map of Canada will be the ultimate outcome.

Owing to the varying conditions in the different parts of the country the detail in soil surveys will always be influenced by the nature of the local problem and the purpose of the undertaking; but, as the work progresses and expands in each province to the limits of the provincial boundaries, there arises the necessity of correlating the soils in one area or province with those in another and in "tying in" the soil boundaries on one side of a provincial line with those on the other. Therefore, while the detail of *soil mapping* in a local area must necessarily be determined by the nature of the project, nevertheless the *classification of the soils mapped* should be on a common basis which will permit the co-ordination and correlation of the soils in any area with those in other areas and in other provinces.

The difficulty which arises in this connection is the handicap of not having to date a universally accepted, scientific scheme of soil classification which is usable in the field, comparable, for instance, to the classifications recognized in the biological sciences. This is due to the fact that soil science is a relatively new science and the data about soils must be acquired before a complete scientific classification scheme can be evolved.

It is not necessary to give here a complete review of all the soil classification schemes that have been used in the past, or are in use now, or that have been proposed for use. An excellent history of these has been published by Afanasiev (*2*) which will be familiar to all soil workers. These schemes represent the changes in concept with the increase in the knowledge of the complex group of objects which we call soils. It is sufficient here to state that it is by reason of the complexity of soils and the failure to recognize them as distinct natural objects that their study was formerly treated either as a branch of physics, geology, chemistry or agronomy, with the result that both the terminology and classification schemes used have been of varied kinds and expressive of various viewpoints. Thus the schemes of Yu (*10*) Thaer (*6*) and Hopkins (*8*) were based on physical properties; those of Fallou (*6*) Richtofen (*6*) and d'Ossat (*4*) were based

[1]Presented to the Soils Group Section meeting C.S.T.A. 11th Annual Convention, Guelph, June 24th, 1931.
[2]Professor of Soils.

on the petrological composition or the kind of parent material upon which the soils were developed; those of Dokouchaeff (*6*) Siberceff (*6*) Glinka (*6* & *7*) Ramann (*13*) and Vilensky (*18*) were based on the climate or the processes or forces responsible for the genetic soil characters; those of Knop (*6*) Wyssotski (*6*) Tumin (*2*) Gedroitz (*9*) and de Sigmond (*5*) were based on chemical properties; those of Comber (*3*) Neustreuv (*2*) and Aarnio and Stremme (*1*) were based on characters due to chemical changes; that of Shaw (*14*) was based on varied categories with latin names; those of Stremme (*15* & *16*) and Marbut were based on so called "pedological" or soil characters expressed in those elusive objects known as mature profiles; and that of the U. S. Bureau of Soils (*17* & *12*) based on texture and a combination of characters described as a series but given a geographical or place name.

However, each of the various schemes of soil classification used in the past has its own advantages and insofar as any of them are based on characters possessed by soils, they will eventually be included as part of the complete scientific scheme that will ultimately crystallize out of the mass of soil data being accumulated by soil scientists throughout the world.

It will be admitted that the gathering of facts about soils is a necessary prelude to their scientific classification; but the soil surveyor who is gathering the facts is faced with the immediate need of a usable field system of classification which will provide for the placing of any and every soil found in an area whch is beng mapped into categories capable of ready interpretation by others, and which will permit of reclassification by any other scheme desirable later. This will readily be appreciated by field workers who have tried and found unsatisfactory for field use the academic schemes of classification which are based on mature profiles only.

A field scheme of soil classification to be satisfactory for our use in Canada should possess the following features:—

1. It must have a place not only for soils with mature profiles, but also for every soil found in the field.

2. It must be capable of expansion in the lower categories to include for local use the finer distinctions used in detail soil mapping or in the study of specific problems.

3. It must provide for the grouping of each local soil complex into categories which show the relationship of local soils found in association with each other.

4. It should provide higher categories of genetic groups, described, named, and grouped on the basis of the chief morphological characters which will permit of easy comparison with the soils of other countries.

In the Manitoba Soil Survey which is conducted by federal and provincial co-operation, we have adopted, with slight modifications, the Nikiforoff[3] scheme of field classification which possesses the above features. After trying it out in the field we have found it to be simple, efficient and satisfactory, and we would earnestly commend its use to soil workers

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throughout the Dominion as a means of co-ordinating the field work of the soil survey. The basis of the scheme is the grouping together into a category called an "association", the genetic soil types or "associates" which are found together on the same geological parent material in any given physiographic region. The associations which are found in any given physiographic region constitute a combination; and the combinations in a climatic soil region or belt, constitute a zone.

The writer's acquaintance with the scheme is the result of numerous consultations with Dr. C. C. Nikiforoff during the progress of the soil survey in the Red River Valley which is being carried on by both workers on either side of the International Boundary. To Dr. C. C. Nikiforoff the writer would express grateful acknowledgment for the concept of the scheme, and for the privilege of presenting it to Canadian workers for their immediate use.

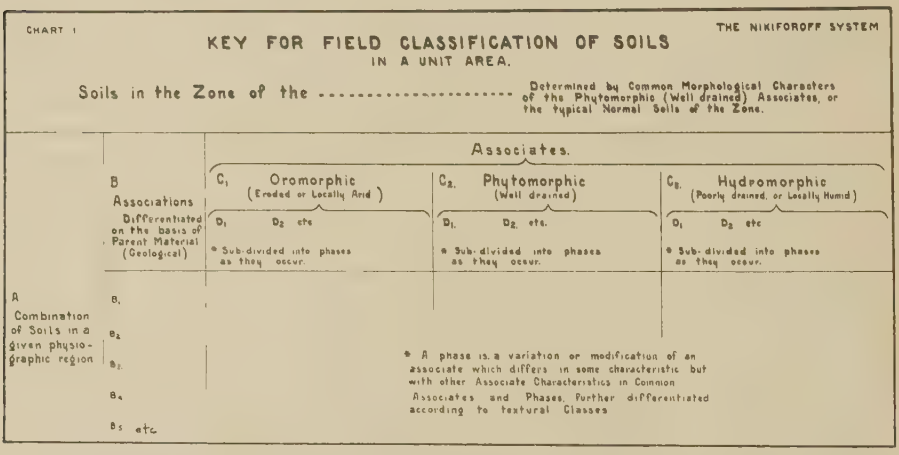


CHART 1
THE NIKIFOROFF SYSTEM
KEY FOR FIELD CLASSIFICATION OF SOILS
IN A UNIT AREA.
Soils in the Zone of the .....
Determined by Common Morphological Characters of the Phytomorphic (Well drained) Associates, or the typical Normal Soils of the Zone.
Associates.
B Associations Differentiated on the basis of Parent Material (Geological)
C1 Oromorphic (Eroded or Locally Arid)
C2 Phytomorphic (Well drained)
C3 Hydromorphic (Poorly drained, or Locally Humid)
D1 D2 etc
* Sub-divided into phases as they occur.
A Combination of Soils in a given physiographic region
B1
B2
B3
B4
B5 etc.
* A phase is a variation or modification of an associate which differs in some characteristic but with other Associate Characteristics in Common
Associates and Phases, Further differentiated according to textural Classes

The Nikiforoff scheme of field classification of soils which is outlined in Chart No. 1 may be simply presented by briefly describing its categories:

1. The Zone.
2. The Combination.
3. The Association and the Associates.
4. The Phase.

1. *The Soil Zone*: (*based on genetic type of the phytomorphic soils.*)

The highest category is the Zone. The zones are the recognized soil zones of the world, and the additional zones or sub-zones which may be established. (*2, 6, 11, 13*). The names of the zones are determined from the common morphological characters of the typical zonal soils usually exhibited in the well drained or phytomorphic associates.

For example: Soils of the Chernozem or Black earth zone.
Soils of the Grey forest zone.
Soils of the Braunerde zone, etc.

2. *The Combination*: (*based on the physiographic regions within the zone*). All soils developed in a given physiographic region constitute

a combination. A zone may cross a number of physiographic regions and each physiographic region within a soil zone will have its own combination of soils. For example: in the chernozem zone in Manitoba there is the Red River Valley combination, the Assiniboine Delta combination, the Morainic Drift region combination, etc. Similarly, each zone will have its own members of combination.

3. (*a*) *The Association*: (*based on geological parent material.*) An "Association" includes the genetic soil types or "associates", found in association on a given parent material. In each combination (or physiographic region) within a given zone, soils are developed on different parent materials and although the well drained members have much in common there may be distinctive differences due to the parent materials which are recognized in all soil mapping. For example: the soils of the Red River Valley constitute a combination in the zone of the chernozem, but in this combination the chernozem soils developed on the lacustrine fine clays differ from the chernozem soils developed on the littoral deposits, etc. Hence, such differences in the well drained soils which are due to the character of the parent material, become the basis of differentiation of a combination into associations.

(*b*) *The Associate*: (*determined by relief and local environment*). The difference in the morphological characteristics of the associates which are the basis of the sub-divisions of an association, are largely the result of the topographic conditions or "macro-relief" which have been responsible for the changes in the soil climate. Three distinct types of "associates" are recognized:

1. The oromorphic associate.
2. The phytomorphic associate.
3. The hydromorphic associate.

1. The "oromorphic associate", when present, is characterized by being locally arid. An association may be in a region which has a mean rainfall of twenty inches, but because of "run-off" the soils which occupy the higher positions of relief will have a water interception of less than twenty inches; hence, these soils will have a locally arid soil climate in comparison with the less hilly portions, and this difference in the soil climate will be reflected in the soil profile. Moreover, erosion is a correlative of "run-off" and the higher portions of relief such as knolls or hills may have soil profiles modified by erosion. Soil profiles in such positions are under the influence of oromorphism, and when present are defined as "the oromorphic associate". In areas with a more or less level topography this associate may not be present.

2. The "phytomorphic associate" of any association is the normal soil of the zone developed on the geological parent material which comprises the association. It is the result of the equilibrium reached by a soil in the well drained position for the time the parent material has been under the influence of the climate and the plant cover. Therefore the phytomorphic associates of the various associations constitute the normal or zonal soils of the combination in each zone. In the mature profiles these

associates are characterized by the morphological features which are typical for the normal climatic zonal soils. (*2, 6, 11, 13*).

3. The "hydromorphic associate" of each association is characterized by being locally moist in comparison with the phytomorphic associates. The hydromorphic associates are under the influence of hydromorphism, the extreme characters of which are evidenced by the presence of a glei-horizon, reduction processes, and mottled subsoil colors. Such soils are found occupying the low positions in relation to relief. The type of hydromorphism, however, is dependent upon the zone. In arid climatic regions the local hydromorphic associates are generally under the influence of halomorphism and saline and alkalinized members known as the halomorphic associate will be found; whereas, in normally humid climatic regions the hydromorphic associates may develop as organic soils, or peat, depending upon the degree of hydromorphism. If all the soils in any association are well drained the hydromorphic associate will not be present.

Although associates are determined very largely by relief or position, they must not be mapped on position but on the basis of the morphological features expressed within the soil profile, and moreover it must not be assumed that the three associates must necessarily exist in any association. In a level area only phytomorphic and hydromorphic associates may be present. In well drained areas with smooth topography only phytomorphic associates may be found, or if the area to be mapped is small and low lying it may be possible that the hydromorphic associate only is present.

The divisions between associates are not distinct in nature, but the transition types, where they exist, can be established as phases such as the phyto-hydromorphic or the hydro-halomorphic phases, etc., to take care of these transitions. In a general reconnaissance survey the establishing of the associates and the mapping of associations is all the detail which will be required. In the more intensive reconnaissance surveys the associates will be mapped out and will become the unit in soil mapping. In detailed soil mapping further subdivision will be required to show the variations found within the different associates. These are classed as phases.

4. *The Phase*: (*or subdivision of an Associate.*) In detailed mapping where finer distinctions are noted the variations of an associate may be separated out as phases. Transitional soils from the hydromorphic to the phytomorphic may be classed as the "phyto-hydromorphic" or "better drained phase" of the "hydromorphic associate". Similarly where salinization accompanies hydromorphism the soils would be classed as the "hydro-halomorphic phase". Strictly speaking, however, a phase is a variation of an associate in respect to some character difference but with all other characters in common. Thus an associate may be described as "bouldery phase", "wind blown phase", "stony phase", etc. The term "wooded phase" or "meadow phase", etc., can be used to denote the modifications in character caused by the superimposition of other forces. The basis of separation in each case is a character difference which can be observed in either the depth, color, structure, texture, consistency, and constitution or

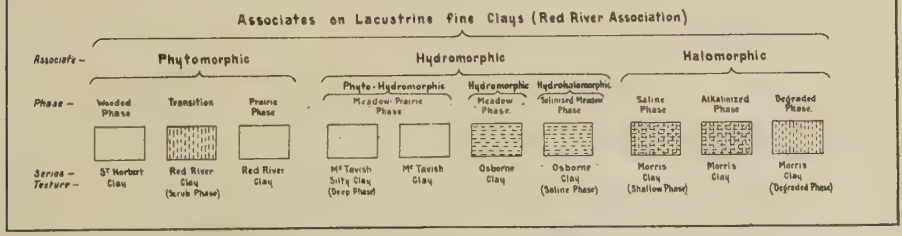
reaction of the various horizons in the soil profile. The Nikiforoff system provides for the classification of minor variations of soil profiles which are caused by variations in "micro-relief" into categories known as "family" and "complex". These will not be elaborated here because they are of little importance in a general scheme of field classification for use in the soil survey projects in progress in Canada. These finer separations are for use in the intensive mapping of experimental plots or very small areas, and in plotting same on large scale maps. The sub-division of the associates into phases provides for all the detail required in the Canadian soil survey with the additional sub-division of associates and phases into textural classes which is usually required in detailed projects.

In this scheme which we are using, the associates and phases correspond to the series units used in the United States Bureau of Soils system, but with this outstanding difference from a correlation standpoint. In the series system of naming soils, local geographic or place names, are used; but there is nothing in the names except the textural ending which refers to the soil or its characters, or that shows the relationship of soils which are found together in the same area. Each series is a separate unrelated unit, and whatever may be the advantages of the series system for purely local use, its general use results in a multiplicity of names which are meaningless and confusing to anyone not familiar with them. The Nikiforoff system, on the other hand, simplifies soil mapping and shows the relationship of all the soils found in association in the field. The use of descriptive names which can readily be understood enables anyone easily to form a logical conception of the soils from maps prepared on this basis. Under this scheme the individual units are co-ordinated into natural groups each of which is composed of a complex of individual soils found side by side in the field. Later, when the facts about all the soils are brought together as a result of the labors of independent workers in the various areas, the soils mapped by this scheme can be re-classified if required by any scheme desired because its categories include and co-ordinate the genetic, geological and physical characters, etc., of the diverse single character schemes of other workers.

An illustration is given in Chart 2 which shows how the series system of naming (or numbering) soils, which has been adopted by so many workers, can be simplified for interpretation and co-ordination under the Nikiforoff scheme of field classification. This chart is a copy of the legend

CHART B.

Example of Method used in the Manitoba Soil Survey, of Sub-dividing an "Association" to show how the Series system of naming Soils may be coordinated and combined with the Nikiforoff System outlined in Chart I.



which accompanies the map of the Red River Valley soils in Manitoba prepared by the writer and his co-workers. It shows in key form the soils mapped as the Red River Association, which constitute the soils developed on the lacustrine fine clays of Lake Agassiz in the zone of the chernozem. The associates of each association are grouped similarly. We would recommend that even though the series system of naming or numbering soils may be retained for local use if desired, that the legend on Canadian soil maps should be presented in a similar form to that in Chart No. 2 so that the key is included with the soil names or (numbers) for simplification and correlation. For example: the series names Red River clay or Osborne clay, when shown alone, mean nothing to one not familiar with them except that such soils are heavy in texture. The key shown in Chart 2 however, indicates at once that Red River clay is the "well drained associate" developed on lacustrine clay in the zone of the chernozem, and hence Red River clay is the typical climatic soil of the zone on heavy textured parent material, i.e. chernozem or "black earth" on clay. Osborne clay, non-salinized phase, is its "hydromorphic associate" and hence it is a "wiesenboden" or meadow soil. Osborne clay (salinized phase), being classed as "hydro-halomorphic phase" of the "hydromorphic associate", would be a "solonschak". Morris clay in the legend is shown to be the "alkalinized phase" of the "halomorphic associate" of the Red River clay and therefore it is a "solonetz". Morris clay (degraded phase) would be a phase of the halomorphic associate developing into "solodee". McTavish clay shown as the "phyto-hydromorphic phase" is the transition from the meadow to the prairie associate. St. Norbert clay is the "wooded phytomorphic associate" and hence it is "an immature degraded chernozem". Thus by naming each soil as an associate, or phase of an associate, on the basis of the characters within the various soil profiles, and then grouping them into associations according to the kind of parent material on which they are developed, the relationship of each soil is established, and a map carrying such a legend is easily interpreted.

In addition to advocating that the legend on soil maps be shown in key form, a further suggestion is made by the author as an aid to the simplification of soil maps. This is also shown in Chart 2. The associates are indicated by a system of broken lines superimposed over the base colors. A separate color is used for each association and the phytomorphic associate is shown without modification; phases and textures are shown by percentage of color in the usual way. All hydromorphic associates have the same base color as their respective phytomorphic associates, but in addition they have horizontal broken green lines superimposed, implying the presence of ground water in the profile. Vertical broken green lines imply leaching processes involved by woodland invasion or acid leaching. (These would not be required in maps where podsols were the normal phytomorphic soils). Halomorphic soils are hatchered with broken red lines over the association color. Broken horizontal red lines imply hydro-halomorphic associates or solonschaks. Cross hatchered broken red lines imply solonetz, and broken vertical red lines indicate the soloti condition of soda leaching. Oromorphic associates would be shown by diagonal broken lines if required.

In view of the situation which exists in Canada in connection with the soil survey we present the above field system of soil classification for the consideration of Canadian workers. We have tried the scheme in the field and found it simple, effective and satisfactory, and we would urge the co-operation of Canadian soil survey workers in adapting the scheme to each local area with the object of (1) unifying the survey projects, (2) simplifying the survey maps, and (3) facilitating the correlation of soils throughout the Dominion.

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A PRELIMINARY INVESTIGATION ON DETERMINING THE "AVAILABLE" PHOSPHORUS IN SASKATCHEWAN SOILS.

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Numerous chemical methods have been proposed, and used, in an effort to determine the fertility of any given soil with respect to phosphorus. That methods designed to give the total, or nearly the total, amount of phosphorus in a soil, gave little or no indication of the readiness with which the soil would supply the growing plant's need for that element, was early recognized by agricultural chemists. Liebig (*6*) mentions analyses made by a Dr. Zoeller in which dilute muriatic acid was used as an extractant of certain soils. The quantities of SiO_2, K_2O and P_2O_5 extracted were determined in an effort to differentiate chemically between a good wheat and a poor wheat soil. Dyer's (*3*) proposal of 1 per cent citric acid as an extracting solution in soil analysis, and the work of the Hallé station (*7*) in Germany, turned attention to the use of weaker extracting solutions in an effort to determine the "availability" or "activity" of the phosphorus present in the soil. The desirability of a chemical method as a basis for recommending phosphate treatments for soils is obvious.

A number of workers have used very weak solvents in their investigations of this problem. Water, and carbonated water, have been used as solvents by several investigators. Harrison (*4*) used a K_2CO_3 solution as an extractant in some studies on calcareous soils. Moore (*8*) found that .02 normal HCl dissolved phosphorus from a soil in amounts comparable to that removed by the plants grown on the soil in pots. Truog (*12*) used .001 N. H_2SO_4 as a solvent and determined the amount of phosphorus in the extract by a modification (*14*) of the sensitive coeruleomolybdate reaction of Denigès (*2*). The results obtained by analysis agreed with the known response of the soil to phosphate applications. More recently the same author (*13*) used a sulfuric acid solution buffered with $(NH_4)_2SO_4$ as an extractant.

While investigating some modifications of the latter method at the Soils Department of the University of Wisconsin[2] several years ago, the writer became interested in determining the "availability" of the phosphorus in some Saskatchewan soils. The neutralizing effect of the soil upon the extracting solution was determined. It was noted that a heavy loam soil which had a reaction of pH 8.4 changed the reaction of the extracting solution from pII 3 to 4.2 during the extraction. Acid, or slightly acid soils generally gave a change of about 0.2 to 0.3 units of pH towards alkalinity. It was obvious that if the method were to be used successfully on soils which are frequently alkaline in reaction, it would be necessary to prevent too great a change in the acidity of the extracting

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[2]Work done as a graduate student under the supervision of Professor E. Truog, to whom the writer is indebted for advice and helpful criticism in this study.

solution during the extraction. From a number of extracting solutions tried, a solution of $KHSO_4$ buffered by adding K_2SO_4 and having a reaction of pH 3.0 was selected as the most suitable. While the amount of phosphorus extracted by such a solution is comparable to that obtained in extracting acid or slightly acid soils with a sulphuric acid solution of like reaction, the buffering effect is great enough to prevent any considerable change of reaction during the course of extracting soils which are as alkaline as pH 8.4. The buffered solution is easily prepared and has an additional important advantage in that clear filtrates are readily obtained. The preparation of the solution is described under the heading "Methods".

It was thought advisable to obtain information as to whether the amount of "available" phosphorus found in a soil by this method might vary with the season of sampling. Accordingly samples were collected from three plots at the University farm on different dates. The data are given in table 1. Date of sampling does not appear to have affected the results of the analyses in these cases.

TABLE 1.—*Effect of season of sampling on the "availability" of phosphorus.*

PLOT 1		PLOT 2		PLOT 3	
Date sampled	"Avail." P. p.p.m.	Date sampled	"Avail." P. p.p.m.	Date sampled	"Avail." P. p.p.m.
Fall 1929	70	June 1930	54	June 1930	52
April 1930	70	July 1930	51	July 1930	53
		Aug. 1930	54	Aug. 193	52

An excellent opportunity to check the method against crop response to phosphate treatment presented itself in the extensive cooperative tests carried on throughout the prairie provinces during the past few years.[3] The yield data obligingly supplied by various cooperating parties, have of necessity been used freely in the preparation of this paper.

A number of soil samples collected from the 1929 plots were analysed for total phosphorus. The variation in total phosphorus, it will be noted, was not great in the soils studied in this manner. In analyses made in connection with the Saskatchewan Soil Survey (*10*) the writer has observed variations in total phosphorus of from .03 to over 0.1 per cent expressed as elemental phosphorus on the oven dry sample. The average of the analyses for total phosphorus published in this paper is probably higher than the average of the analyses made on Saskatchewan soils. The results for total analyses are included in table 2. The reaction determined colorimetrically, the texture as determined in the field, and the colour when dry are also given in table 2, together with plot location, yield increase, and "available" phosphorus expressed as parts per million elemental phosphorus.

[3]The writer wishes to express thanks to the farmers who willingly assisted in obtaining soil samples; to the staffs of the Experimental Stations for their cooperation in obtaining samples and forwarding yield data, particularly at Scott, where many samples were collected; to the members of the Soils Department at the University of Saskatchewan, for much assistance; to Dr. R. E. Neidig of the Consolidated Mining and Smelting Company for yield data, and for his willing cooperation; and to all others who directly or indirectly made this data possible. Note.—The analytical work was done at the Soils Department, University of Saskatchewan.

TABLE 2.—*General table giving location of plots, soil description, results of analyses, and percentage yield increase on treated plots over check plots taken as 100.*

Cooperator's Name	Location (Town)	Soil Description*	pH by Indicators	% increase yield over check plot	"available" P. in parts per mil.	Total P. % on oven dry sample
Experimental Sta. (1929)	Scott	Brown loam	6.8	58	7	.072
Experimental Sta. Rot. "C" (1930)	Scott	Brown loam	6.6	54	6	
Experimental Sta. Rot. "J" (1930)	Scott	Brown loam	6.6	52	8	
Martin	Phippen	Brown loam	6.8	83	6.5	.073
Wehrhahn	Rockhaven	Brown loam	6.2	30	6	
Jack	Cutnife	Dark brown loam to light loam	6.7	47	7	
Love	Scott	Brown loam	6.6	48	9	
Neufeld	Evesham	Dark brown light loam	6.5	29	9	
Hinchcliffe	Kelfield	Grayish brown loam	6.8	85	12	.083
Silver	Unity	Dark brown very fine sandy loam	6.8	72	13	.051
Schillie	Scott	Grayish brown heavy silty loam	6.4	27	13	.080
Hewgill	Moosomin	Dark gray light loam	6.7	46	13	
Scheidt	Luseland	Grayish brown heavy loam	6.7	54	15	
Brown	Scott	Brown loam	6.4	41	17	.086
McGratton	Tisdale	Very dark gray loam	6.6	22	17	
Anderson	Scott	Dark brown loam	6.7	36	17	
Experimental Station	Rosthern	Dark gray light loam	6.8	19	19	.081
Belyk	Scott	Grayish brown loam	6.6	50	19	
Baron	Reford	Brown loam	6.6	11	19	
Hodgson	Vanscoy	Dark brown light loam	6.7	54	22	
Dreidger	Osler	Dark grayish brown light loam	6.6	57	23	
Robson	Melfort	Very dark gray loam	6.7	14	27	
Hardy	Laird	Gray loam	6.7	23	29	
McPherson	Dunblane	Brown loam	6.8	47	31	
Olson	Robsart	Light brown clay loam	6.8	nil	31	
Knowles	Unity	Brown heavy loam	6.6	27	31	
Wright	Kerrobert	Brown heavy loam to clay loam	6.5	52	32	
McNeil	Alameda	Brown loam to light loam	6.6	17	33	
Swanston	Shaunavon	Brown loam	6.5	17	33	
Brooks	Rosthern	Dark grayish brown silt loam	6.8	14	43	
Mutschler	Fox Valley	Light brown silty loam	7.0	−10	45	
University Farm (1928)	Saskatoon	Grayish brown clay loam	7.7	nil	53	
Day	Armley	Gray loam	6.7	12	58	
University Farm (1929)	Saskatoon	Grayish brown heavy loam	6.8	nil	59	.069
Buchanan	Rosetown	Light grayish brown clay	7.8	23	60	
University Farm fertility plots	Saskatoon	Grayish brown heavy clay loam	8.0	nil	67	.075
Simpson	Kindersley	Light grayish brown clay	8.2	140	76	
Experimental Farm	Indian Head	Dark grayish brown heavy clay loam to light clay	6.9	10	86	
Whatley	Kindersley	Light grayish brown clay	7.8	6	160	

*These soils were classified by location, color and texture rather than by series and types because the latter system had not been completely worked out by the Saskatchewan soil survey.

The plots from which samples were obtained were 1928-29-30 tests, conducted mainly on summer fallow wheat crops. The treatment was triple superphosphate drilled with a fertilizer attachment drill. In four cases results from ammoniated phosphate treatments are used, because superphosphate plots were not included in the test. The writer is of the opinion that this introduced no serious error in the date. The samples upon which the analyses are reported are from the check plots. Where more than one check plot was included in the test the results were averaged, and where more than one rate of application was made, they also were averaged. This was advisable for two reasons: first, the rate of application varied for the plots studied, so that one rate could not be used as a basis for yield data throughout, and secondly, inspection of the yield data indicated that differences due to plot variation would be lessened by such a procedure. The percentage increase yield of treated plots against the check plot yield as 100, is taken as an index of the soil's response to phosphorus.

The plots from which these data were obtained were scattered quite widely over the province, as will be seen by the locations given.

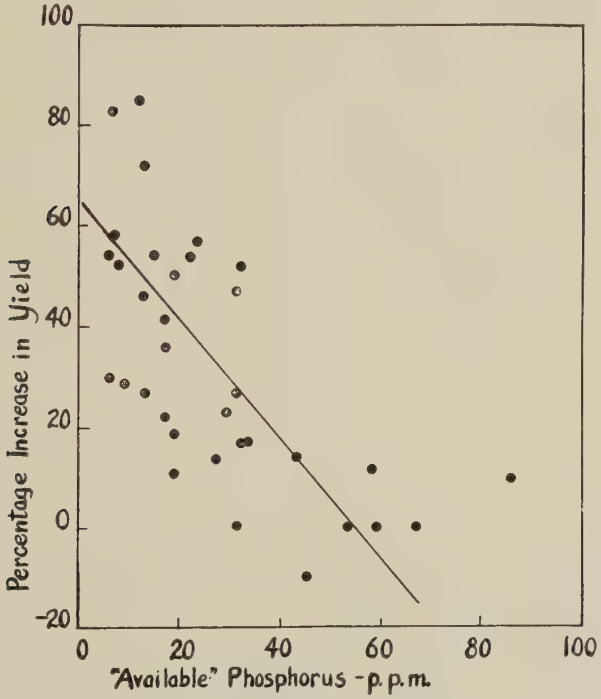

Figure 1. Relation between increase in yield from phosphate treatment and the available phosphorus of the untreated soil.

In figure 1 the yield increase in per cent over the check plot yields is plotted against phosphorus in parts per million air-dry soil as determined by the method given.

Discussion of Results

In plotting the data as shown in figure 1, only results obtained from soils lighter than clays were used. The data obtained from soils classed as clays were not plotted since there is a possibility that clays may be more responsive to phosphate treatments than the lighter textures. Russell (*9*) mentions that clays generally give responses to phosphorus and suggests that it may be due in part to stimulated root development. However, with the exception of the Simpson plots, the clays seem to give responses that agree fairly well with what might be predicted from the results of the analyses. Figure 1 indicates a general decrease in response to phosphate treatments as the "available" phosphorus increases, the coefficient of correlation being $-.67 \pm .06$.

It might be mentioned that the results reported here do not include the widest variations in "available" phosphorus found in Saskatchewan soils. Two "park belt" loam samples gave 74 and 82 parts per million phosphorus by this method, a "gray timber" (*5*) loam 3 parts per million and a Regina clay (*11*) sample 50 parts per million. These samples were gathered in the course of regular soil survey work.

The data furnished herein indicate that the method as described may be used with some confidence as a guide to recommendation of phosphate treatments, particularly in the production of wheat and other small grains. Soils showing an "availability" of less than 20 parts per million phosphorus seem likely to give very substantial increases from phosphate applications. Up to 40 parts per million a marked response is still probable, while at 50 or 60 parts per million only slight responses are likely except for heavy textured soils. This relationship between "availability" and response is likely to hold for the grasses and corn, as well as for the small grains. However, it would be unsafe to assume similar relationships to hold for the legumes, sugar beets and potatoes, since different crops are known to differ in their response to the kind of phosphate fertilizer used (*1*) and in their ability to feed upon the phosphates present in the soil. Where "availability" is quite low a response would be probable from most of the field and garden crops.

The method is rapid, relatively simple, and the phosphorus extracted may be determined with an accuracy of less than 2 parts per million error.

The Method

The preparation of reagents, and also the time of extraction and ratio of soil to extracting solution is similiar to that outlined by Truog (*13*) except that an extracting solution of $KHSO_4$ buffered by adding K_2SO_4 is used. This solution is prepared as follows:— Dissolve 10 grams $KHSO_4$ in 1 litre H_2O. Dilute 34 cc.s of this solution and 5 grams K_2SO_4 to 1 litre. The resulting solution has a reaction of pH 3. It is convenient to prepare a large volume of this solution if many samples are to be analysed. Since extremely small amounts of phosphorus and arsenic are sufficient to seriously affect the results by this method, all reagents must be carefully tested. K_2SO_4 usually requires recrystallization to obtain it sufficiently pure. Potassium bisulphate of good grade may generally

be used without further purification. The writer wishes to emphasize the necessity of observing the precautions given by Truog and Meyer (*14*) and Truog (*13*) if satisfactory results are to be obtained.

Summary

Using a slight modification of Truog's method a study of the correlation between increase in yield from phosphate treatment and the available phosphorus of the untreated soil is reported.

The conclusion is reached that for soils lighter than clays where the "availability" of the phosphorus is below 20 parts per million as found by this method large increases in grain yields may be expected from phosphate treatments of the soil. With an availability of from 20 to 40 parts per million a response is still probable, while at 50 to 60 parts per million "available" phosphorus, the point is reached where little or no response is likely.

A wide variation in the "availability" of the phosphorus in Saskatchewan soils is noted.

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III. STUDIES ON THE REACTION OF DISEASE ORGANISMS TO LIGHT.

The Reaction of Disease Organisms to Certain Wave-Lengths in the Visible and Invisible Spectrum[1]

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1. Reaction to ultra-violet light; wave lengths shorter than 400 $\mu\mu$.

Reaction of Organisms in Culture to Ultra-Violet Light.

In a recent paper (*1*) the writer described the effect of ultra-violet light from an artificial source on the development of certain disease organisms. It was shown that vibrations of these wave-lengths could have a profound influence on the development of organisms in culture and could exert a marked retarding action on their growth. In culture *Mucor mucedo*, *Fusarium* sp., *Sclerotinia trifolium* and *Stereum purpureum* showed intolerance to light emanating from a sun lamp in that they grew more slowly and penetrated deeper into the medium.

Growth, therefore, may be retarded by vibrations in this band.

The following experiment, however, will indicate that retardation of this nature may result subsequently in an acceleration of the development of the organism.

For example, cultures of a *Fusarium* (*F. culmorum*) were given one irradiation for different periods with light from a sun lamp.

The primary reaction was one of retardation; subsequently however, these irradiated cultures sporulated very abundantly whereas the non-irradiated cultures sporulated sparsely. This observation is in keeping with the work of Bailey (*2*) who finds that ultra-violet irradiation is effective in increasing the amount of sporulation in various species of *Fusarium*. Growth therefore may be accelerated by vibrations in this band.

In correlating two such opposites it is assumed here that the initial retardation forces the organism to an earlier maturity.

Reaction of Germinating Spores to Ultra-Violet Light with Reference Specifically to the Germination of Urediniospores of Certain Physiologic Forms of Puccinia graminis tritici.

The writer (*3*) has shown that one of the functions of the pigment in the epispore of certain spores is to prevent injury from ultra-violet light. Broadly, it is analagous to the pigment melanin in man.

The following table 1 is abstracted from the work referred to above and it shows the relative germination percentages of urediniospores of Form No. 1 (red, grey, orange and white selections) when irradiated for periods of 15, 30, 45 and 60 minutes, 1 foot from a small model Hanovia Sun Lamp.

[1]These observations are based on preliminary experiments that were carried out at the Dominion Rust Research Laboratory, Winnipeg, Manitoba.

[2]Exchange officer stationed at Dominion Rust Research Laboratory, Winnipeg, Manitoba, during 1930-31.

TABLE 1.

Form	Relative number of spores germinating				
	Minutes irradiated				Non irradiated
	15	30	45	60	
No. 1 White	1	0	1	0	100
No. 1 Orange	7	9	2	0	100
No. 1 Grey	47	34	6	20	100
No. 1 Red	41	33	12	2	100

These figures show that the grey and red forms have a high power of resistance to ultra-violet light since it has taken three quarters of an hour to kill the major portion of them. The white and orange selections, however, are more susceptible to injury. The major difference in these selections is this: In the white and orange there is no pigment in the epispore, in the red and grey, pigment is present.

The technique in this and similar experiments was to dust the spores lightly on the surface of 10 cc. of distilled water contained in Syracuse dishes and immediately to irradiate them.

In other experiments instead of irradiating the spores directly they have been dusted on water, they have been allowed to stay on the surface for certain periods prior to irradiation.

In table 2 the results of one such experiment are tabulated. This table shows the relative germination percentages when urediniospores of Form No. 36 (red selection) were kept on the surface of water for 1 hour and 15 minutes and then irradiated at a distance of 1 foot from the lamp for periods ranging from ten to two minutes.

TABLE 2.

Period of irradiation in minutes	Relative germination percentage at, approximately, the time of irradiation	Relative germination percentage		
		3 hrs. later	4 hrs. later	18 hrs. later
Nil	Varied from 11 to 46, the average being 27	87	89	100
10	do	22	20	22
8	do	33	40	33
6	do	27	20	29
4	do	18	16	22
2	do	81	80	83

These figures indicate that once germination has commenced and protoplasmic change has taken place in the spores they are much more susceptible to ultra-violet light injury. Since germination was already in progress at the time they were subjected to light it follows that the germ tubes and incipient mycelia are more susceptible to the lethal action of ultra-violet than are the spores themselves.

Other experiments of a similar nature confirm the results in the above tables.

2. THE EFFECT OF IRRADIATING HOST PLANTS INFECTED WITH *Puccinia graminis tritici.*

Four sets of the twelve differential hosts used for the determination of physiologic forms were inoculated with Form No. 36 of *P. graminis tritici.* As is customary they were then placed in the moist chambers for forty-eight hours, after which each set was irradiated in separate experiments for respectively 15, 30, 45 and 60 minutes a day for six days. The source of light was a large model Luxor Sun Lamp, and the plants were irradiated at a distance of 38 inches.

As this experiment progressed it was evident that the hosts reacted differently to ultra-violet light. In many cases it was observed that the leaves were injured by the light. The green in the leaves changed to a grey-green colour and had an appearance similar to that which would occur if they were slightly scorched by fire. Leaves badly injured did not recover but in no case was a plant killed completely. Later the injured leaves became yellow. From this experiment it was concluded that these hosts varied in their tolerance to ultra-violet light.

They were grouped in the following three orders:

Injury severe:	Kubanka
	Kota
	Speltz Marz
	Arnautka
	Acme
	Mindum
Injury less severe:	Einkorn
	Vernal Emmer
	Marquis
	Kanred
Injury very slight:	Little Club
	Khapli

It is of interest here to note that with one exception, Kota, the varieties most susceptible to injury were all *durums.* Of these durums it was considered that Kubanka showed slightly less injury.

In a similar experiment inoculated sets of these differentials were irradiated for 2½, 5, 7½, 10 and 15 minutes a day for six days, at a distance of 2 feet from the lamp.

No injury resulted from the 2½ minute exposures, but in the 5 minute exposure injury was observed on Mindum, Arnautka, Acme, Speltz Marz, Einkorn, Kota, Kubanka, Kanred, but not on the remainder.

In the case of the 7½ minute exposure there was very noticeable injury to Arnautka, Kubanka, Einkorn, Acme, Mindum, Speltz Marz and slight injury to Kanred, Marquis, Vernal Emmer and Kota, but none occurred on Little Club and Khapli.

In another experiment sets were irradiated for 15, 30, 45, 60 and 90 seconds per day at a distance of 18 inches from the lamp for six days.

As a result of these and the previous experiments the order of the susceptibility of these hosts was arranged as follows:

- Susceptible
  - Very susceptible
    - Speltz Marz
    - Arnautka
    - Acme
    - Mindum
  - Slightly less susceptible
    - Kubanka
    - Kota
  - Moderately susceptible
    - Einkorn
    - Vernal Emmer
    - Kanred
    - Marquis
- Resistant
  - Very resistant
    - Little Club
  - Slightly less resistant
    - Khapli

The observations recorded on the rust reaction in these and other unquoted experiments were as follows.

No striking effect was noted on the rust reaction of these hosts. The formation of the pustules was very slightly delayed but no change took place in the type of pustule or its colour. The intensity of the rust was slightly less for the longer periods of irradiation but this was accounted for by the leaf injury which occurred. In some cases the longer periods of irradiation retarded the appearance of hypersensitive areas.

Experiments that were carried out indicated that the leaf injury which occurred was not caused by heat but by the action of the light.

There was no apparent difference between plants irradiated in the day time and at night.

The leaf injury that occurred 3 feet from the lamp after an irradiation of 1 hour appeared similar to that which took place after irradiation for two hours at a distance of 6 feet.

It was found that rust did not develop on an etiolated plant; also that such plants were more susceptible to both injury from ultra-violet light and normal visible light. Etiolated plants brought into normal light, and also etiolated plants that were irradiated, succumbed to light injury with the exception of Little Club and Khapli both of which, in comparing them with the other differential hosts, appear to be markedly resistant to light.

Ultra-violet light did not hasten the formation of teliospores of *P. coronata.*

Seedlings of these differential hosts were more susceptible to injury than older plants.

Effect of Ultra-Violet Light from the Sun on the Germination of Normal Red Urediniospores.

Experiments that have been carried out in the months of April, May and June indicate that normal red urediniospores dusted on the surface of distilled water contained in Syracuse dishes and exposed to sunshine are not killed.

Germination under such circumstances is inhibited, as a separate study will show (*4*) but this inhibition is no action of invisible ultra-violet light but of visible white light.

Moreover, spores exposed in this way may be killed. This again is not due to ultra-violet light but to heat rays. Exposure of spores to sunlight when the temperature is high, ranging from 32° to 35°C., will kill them, if the exposure is maintained for several hours.

In correlating this inability of the ultra-violet light in sunshine to exert a lethal action on these highly pigmented spores, with the fungicidal action of artificial ultra-violet, it must be stated that the small model Hanovia lamp which was used in the laboratory experiments is, at a distance of one foot, fifty times stronger than the sunlight for wave lengths shorter than 320 μ μ.

It would seem therefore that the pigmentation of a spore is an adequate protection against injury by ultra-violet light emanating from the sun.

Here it is not proposed to discuss the action of natural ultra-violet light on non-pigmented spores. It is, however, of interest to record from one's own field observations on disease organisms that in the majority of cases the fungi with non-pigmented spores seem to show an intolerance to visible light. Infection takes place away from the high light intensities (or in darkness) on the under surface of leaves, at the base of stems, at soil level, on the shade cast on the host by other vegetation, etc. This aspect, however, is considered in a separate study where the action of certain wave lengths in the visible spectrum will be discussed.

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FOUR YEARS' OBSERVATIONS ON THE EYE-SPOTTED BUDMOTH *SPILONOTA OCELLANA* D. & S., IN NOVA SCOTIA.

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The eye-spotted budmoth, *Spilonota ocellana* D. & S. has been a pest of fruit trees for a great many years, the species having been described from Austria in 1776. Like many of our economic insects therefore, this species is of European origin. Just when it was imported into America is not definitely known, but it apparently was first recorded by Dr. Harris in 1841, from the State of Massachusetts. The insect disseminated rapidly and today is found in practically all the temperate fruit growing regions of America. In 1870, it was reported in Canada from the Province of Ontario, and, in 1885, Dr. Fletcher found larvae hibernating on the twigs in Nova Scotia. Naturally an insect pest commanding the attention of entomologists for so long a period has resulted in an extensive bibliography. In glancing through the available literature it is apparent that *Spilonota ocellana* D. & S. is not continuously present in destructive numbers in any fruit growing region, but occurs in periodic outbreaks. In 1869 it was reported as destructive in Massachusetts and Pennsylvania. In 1891 a general outbreak occurred in the New England States and in Nova Scotia. In Nova Scotia our attention was again drawn to this destructive pest in 1914, when a moderate infestation occurred. Again in 1926 an outbreak probably much more severe than previous attacks, spread through Annapolis valley orchards. It must not be inferred from these remarks that the insect appeared suddenly in the years mentioned, at least not in the more recent outbreaks. It requires about two years to reach its maximum numbers and about the same time in descending the scale. In our concentrated orchard areas there is, therefore, at the time of these outbreaks a period of three to five years during which the insect is present in destructive numbers.

In 1926 the writer commenced a study of this budmoth in Nova Scotia. The work was conducted at Annapolis Royal and included biological investigations at the insectary in conjunction with field observations.

It is not the intention in this paper to enter into the bionomics of *Spilonota ocellana* D. & S. in an extensive way as this would largely be duplicating previous work. There are, however, certain phases of the life-history and habits which have not been emphasized or apparently reported by other entomologists. It is mainly intended, therefore, to present in this paper some of these unrecorded notes on the life-history and habits of this insect pest, particularly as applying to Nova Scotia.

Seasonal Life History

In Nova Scotia the eye-spotted budmoth hibernates during the winter as partly grown larvae in small cases or hibernacula. These hibernacula

[1]Assistant Entomologist.

consist of silk tightly woven so as to form a practically waterproof impervious protection. They are found on the outer limbs of the tree, about the buds, in the angles of small twigs, and in various depressions or wrinkles on the fruit spurs. As the buds begin to swell in the spring the larvae emerge to feed upon the buds. The larvae when mature in June, form a small cell from a bit of leaf and pupate among the webbed-together leaves on the trees. In from fifteen to twenty days the adults emerge to deposit their eggs. The eggs hatch in July and the larvae complete a part of their growth previous to hibernation. The majority of the larvae pass the winter in the fifth instar. There is, however, a small percentage that winter in the fourth and a very few that moult a fifth time, thus hibernating in the sixth instar.

There is in all a total of seven larval instars, the writer being unable to obtain any variation from this number even though the hibernating instar is not consistent.

Emergence of Adults. The adults begin to emerge at the end of June or the first week of July, depending upon the season. In 1926 adults did not begin emerging until July 6, while in 1928 they were appearing on June 28. It will be observed from table 1 that the males are the first to emerge, preceding the females by two to three days. The influence of this can be traced throughout the entire period, for the maximum male emergence is reached several days previous to that of the females, and the latter continue to appear for nearly a week later than the males. The females emerging very late in the season were smaller and of lower fecundity than those emerging earlier. The average number of eggs deposited by females mated previous to July 18 was 144.8 eggs while those mated after July 28 only laid an average of 36 eggs.

The males lived in the breeding cages from 6 to 17 days, averaging 11.6 days, and the females lived 7 to 19 days, averaging 13.1 days.

Habits of the Adults. The adults mated and oviposited readily in rearing cages and apparently deposited their full complement of eggs. In the orchard during the day they are found at rest upon the foliage and limbs of the trees, flying short distances when disturbed. They become active at twilight and during the early part of the evening are flying in great excitement about the foliage of the trees. Mating occurs at this time, and in from 24 to 48 hours oviposition begins. The eggs are not all deposited at once but are laid over a period of about one week. The adults are not attracted to light to any extent.

Eggs. The eggs resemble tiny drops of wax and are laid singly or occasionally in small groups upon the foliage. In the insectary eggs were deposited promiscuously on both the upper and under surface of the leaves. In Pennsylvania the moths are reported as ovipositing entirely upon the upper surface of the foliage. In Connecticut, Porter records that eggs were deposited on both sides of apple and pear foliage, but does not state definitely whether this was in confinement or in the orchard. In respect to this habit there is evidently considerable variability in different regions and even comparativelly small local areas indicate lack of consistency one year with another. In Annapolis valley orchards during 1926 no eggs were deposited

TABLE 1.—*Emergence of adults of Spilonota ocellana, D. & S., 1926-27-28.*

Date	1926 Number		1927 Number		1928 Number	
	Male	Female	Male	Female	Male	Female
June 28	..	..	..	..	2	0
29	..	..	..	..	3	0
30	..	..	1	0	20	1
July 1	..	..	11	0	43	7
2	..	..	12	1	36	17
3	..	..	48	10	32	25
4	..	..	25	11	22	24
5	..	..	25	16	8	15
6	2	0	27	33	7	16
7	8	0	24	19	10	29
8	8	4	32	47	8	26
9	10	8	40	66	4	18
10	8	16	50	62	10	20
11	26	12	32	50	6	15
12	14	18	34	47	3	7
13	10	32	29	41	2	5
14	10	14	29	70	2	8
15	10	10	22	50	2	7
16	10	10	20	49	1	6
17	4	16	12	21	1	6
18	1	2	11	19	1	7
19	6	8	8	15	0	5
20	4	12	6	13	1	6
21	6	20	5	7	1	5
22	4	10	2	5	0	4
23	2	6	2	4	1	2
24	2	4	1	2	1	2
25	1	2	0	1	0	2
26	1	2	1	4	0	1
27	4	1	3	8	0	1
28	2	8	0	10	0	2
29	2	2	0	3	0	1
30	0		0	2	0	1
31	2	10	0	1		
Aug. 1	0	4	0	4		
2	0	4	0	4		
3	0	1	0	2		
4	1	2	0	1		
5	0	2	0			
6	0	2				
7	0	1				
8	1	1				
9	0	6				
10	0	4				
11	0	1				

on the upper surface, all being deposited on the under leaf surface. In the following year from 20 to 25 per cent of the eggs were laid on the upper surface. In 1928 a somewhat smaller percentage again was deposited on the upper surface of the foliage. The incubation period varied from 10 to 14 days, averaging 11.5 days for 830 eggs, as summarized in the following table.

Emergence of the Larvae. In an average season eggs begin to hatch about July 15, but due to seasonal variations there may be some departure from this date. The following table shows the hatching dates of the eggs of the eye-spotted budmoth extending over four seasons beginning with

TABLE 2.—*Oviposition and number of eggs laid by Spilonota ocellana, D. & S., 1926.*

Record No.	July																						Aug.	Number of eggs laid
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	
1	♂			75	17			36	34									♂	♀						162
2	♂			41	38			29	2	12	18							♂	♀						140
3	♂			56				30	94			26			♂		♀								206
4					♂			61	5			50			♂	♀									116
5	♂			16	39			44	69						♂										168
6		♂			♀		20	18	31			20		♂								♀			89
7					♂			29	55						♂						♀				84
8					♂			55	20					45					♂						120
9					♂			115	15					65						♂		♀			195
10					♂			57	48					80								♂		♀	185
11									♂		62			105								♂		♀	167
12					♂			67	28					18					♂						113
13									♂		46			79									♀	♂	125
14			♂				42			10			17			89		♂		♀					158

Average number of eggs from early matings, 144.8.

Record No.	July				August																			Number of eggs laid
	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
15	♂			6				25				♂													31
16	♂		45							♂	♀														45
17												♂				32				♂			♀		32
18	♂			30	6	4	8	♂	4	♀															52
19		♂				8		19		15	♂	♀													42
20						♂			14		3	♂		12	♀										33
21								♂			12		9		♂										21
22												♂			21		10		1	♀	♂				32

Average number of eggs from late matings, 36.

♂, ♀ These signs on the left indicate the dates when the males and females respectively emerged, on the right when they died.

1926. It is not intended that the dates in the last column represent the very last eggs to hatch, for in a few instances eggs have been observed after these dates, in fact a few belated females were reared which oviposited considerably later than represented in this table. However, under orchard conditions the number of eggs remaining after these dates is quite small.

TABLE 3.—*Incubation period of eggs of Spilonota ocellana, D. & S., 1926.*

No. of eggs	Date eggs laid	Date eggs hatched	Length incubation period
60	July 12	July 22	10 days
112	" 12	" 23	11 "
15	" 13	" 23	10 "
22	" 13	" 24	11 "
15	" 15	" 27	12 "
79	" 16	" 26	10 "
86	" 16	" 27	11 "
288	" 16	" 28	12 "
63	" 16	" 29	13 "
19	" 17	" 28	11 "
11	" 17	" 29	12 "
41	" 21	Aug. 3	13 "
19	" 21	" 4	14 "

Habits of the Newly Hatched Larvae. The young larvae soon after emerging begin to feed on the under surface of the leaves, usually locating near the mid-rib or one of the larger veins. A small tubular protection is constructed within which the larva rests when not feeding. The leaf is skeletonized about this tubular shelter and over all is spun a thin layer of silk which largely obscures the larva and its resting tube from view. In mild infestations usually only one larva is found on a leaf, but when outbreaks occur several locate and feed on different parts of each leaf. They also feed upon the fruit whenever the infested foliage comes into contact with the fruit surface. The majority moult three times in their feeding shelters after which these latter are soon deserted and the larvae begin to spin their hibernacula. The fourth moult occurs when these are partially constructed.

TABLE 4.—*Emergence of the larvae of Spilonota ocellana, D. & S., 1926 to 1929.*

Year	Locality	Date first larva emerged	Maximum emergence	Hatching practically completed
1926	Berwick	July 22	July 24—Aug. 1	Aug. 17
1927	"	July 17	July 20—July 25	Aug. 3
1928	"	July 12	July 15—July 20	July 30
1929	"	July 13	July 16—July 22	Aug. 1

Hibernation. The period over which larvae commence hibernation is a prolonged one, beginning the latter part of August and extending well into October. This is indicated in the following table.

TABLE 5.—*Hibernation of larvae of Spilonota ocellana, D. & S., 1926 to 1929.*

Year	Started to hibernate	Maximum hibernated	Hibernation practically complete
1926	Aug. 25	Sept. 4—Oct. 1	Oct. 25
1927	Aug. 27	Sept. 5—Sept. 25	Oct. 10
1928	Aug. 19	Aug. 30—Sept. 20	Oct. 15
1929	Aug. 22	Sept. 1—Sept. 20	Oct. 12

It is difficult to determine what stimulates the larvae to desert the foliage to hibernate. When hibernation commences the food is ample in quantity and the composition apparently has not materially changed. The advent of cooler weather towards autumn has frequently been mentioned as perhaps the most important contributing factor. In 1928, however, larvae were beginning to hibernate on August 19 but there was no change from summer temperature in that year until about September 1. It could not be observed that cooler weather hastened hibernation in any way; in fact the effect seemed to be just the opposite. The cooler weather prevailing after September 1, instead of forcing the larvae to hibernate, retarded their development, thus prolonging the duration of the larval instars. Previous to a drop in temperature near the end of August the average length of the larval instars was 7.8 days, while after this date when the weather was cooler, each instar averaged 16.3 days. In no instance under observation did larvae attempt to hibernate, either in the field or at the insectary, earlier in their development than the fourth instar. It would appear, therefore, that there is a natural instinct to hibernate when a certain stage of development has been reached, irrespective of the prevailing temperature.

Emergence of Larvae from Hibernacula. The time of larval emergence in the spring follows closely bud development and, therefore, does not begin on all varieties of apples at the same time. In the Annapolis valley the Gravenstein is one of the earliest to open and when the blossom buds of this variety are just breaking at the tips the larvae begin to emerge from their winter quarters. If warm sunny days continue when this development has been reached the larvae emerge in great numbers; on the other hand if a cold wet period occurs then emergence is not only delayed but may be entirely suspended for several days. The development stage of the bud, however, is not strictly followed for the larvae begin emerging on the late opening varieties before there is the same bud development as upon the earlier sorts. In the Annapolis valley, Spy is our latest opening variety and the larvae are at least one week later emerging from their winter quarters. In most seasons this delay does not find even the Spy blossom buds bursting, and a much larger percentage of the larvae gnaw their way through the bud scales instead of entering at the tips as the majority do on trees more advanced. In the spring of 1927 determination was made of larval emergence from hibernacula on May 17. At this date practically all had emerged on the early varieties; on the mid-season varieties such as Baldwin, Wagner, etc., the larvae still remaining in

hibernacula varied from 5 to 7 per cent, while on Spy there was still 46.5 per cent not emerged. Considering the variability due to season and variety of fruit there is a period of two to three weeks over which larvae are emerging in the spring. Table 6 shows the dates of emergence for a four year period beginning with 1926.

TABLE 6.—*Emergence of larvae of Spilonota ocellana D. & S., 1926 to 1929.*

Year	Date started to emerge	Maximum emergence	Emergence practically completed
1926	May 6	May 13—19	May 22
1927	April 30	May 10—18	May 21
1928	April 29	May 4—11	May 17
1929	May 2	May 7—14	May 20

Habits of Larvae in Spring. If a budmoth hibernaculum is opened just previous to emergence of the larva a marked change will be found to have occurred in comparison with the same hibernaculum earlier in the year. The interior or more delicate webbing immediately surrounding the larva has entirely disappeared and the outer portion, although still intact, is now quite thin and tender, affording scant protection against moisture. The larva itself is semi-active and the integument, instead of being in numerous folds, is now quite full with the body plump. This larval activity is always in progress on warm sunny days from one to three weeks previous to emergence. The last act of the larva before emerging is to make a small circular exit just sufficient to allow it to escape. Weather in Nova Scotia at this time of year is very variable, and frequently with the onset of a cold spell this exit may be formed several days before conditions are favorable for the larva to escape. At the same time it must not be forgotten that with continuous warm days emergence from the hibernacula may be very precipitous. In any event, there is a period varying from four to five days to as long as ten days in some seasons, when the larvae have scant protection in the hibernacula. A very vulnerable point of attack hitherto not previously considered was here found, as certain contact sprays would at this time penetrate the weakened hibernacula, killing the larva within.

The mature larvae are brown with a black head and vary in length from 13 to 15 mm. The widths of the head capsule of the various instars are shown in the following table.

TABLE 7.—*Width of head capsules of larval instars, Spilonota ocellana, D. & S.*

Instar	Number of head capsules measured	Average width
1st	20	.219 mm.
2nd	42	.295 mm.
3rd	21	.388 mm.
4th	35	.476 mm.
5th	89	.552 mm.
6th	41	.707 mm.
7th	73	.993 mm.

Upon escaping from the hibernacula the larvae at once attack a near-by bud. There is, however, only enough of the bud surface consumed to allow entrance, feeding being almost entirely within. Due to the blossom buds opening earlier than the leaf buds, the former are more severely infested, which frequently results in their complete destruction. The following table will show the proportion of infestation of blossom and leaf buds on five leading varieties. It will be noted that there is not as great a contrast in this respect with the Golden Russet variety, this being due to both types of buds opening at nearly the same time.

TABLE 8.—*Percentage of infestation of blossom and leaf buds, 1926.*

Variety	Total buds counted	Divided into: blossom buds	Divided into: leaf buds	Total infested buds	Total per cent infestation	Total blossom buds infested	Per cent. blossom buds infested	Total leaf buds infested	Per cent. leaf buds infested
Gravenstein	410	256	154	183	44.6	164	64.1	19	12.3
Golden Russet	751	383	368	295	39.1	165	43.1	130	35.3
King	575	119	456	93	16.1	50	42.0	43	9.4
Baldwin	606	404	202	176	29.0	153	37.6	23	11.3
Spy	640	204	436	206	32.2	169	42.8	37	8.5

After the buds open, the leaves and blossoms in the individual clusters are tied together, the larvae continuing to feed on the less exposed portions. It was particularly observed during the last instar that there was some migration from bud to bud, especially on warm humid mornings, and at the same time a greater proportion of feeding upon exposed leaf surfaces than previously. The insect is, therefore, more amenable to control with arsenicals near the close of the feeding period.

Pupae. The larvae when mature form a small cell from a bit of leaf or blossom petal and pupate among the tied-together leaves. Pupation begins about the middle of June continuing well into July, as shown in the following table.

TABLE 9.—*Pupation of Spilonota ocellana, D. & S., 1926 to 1929.*

Year	Date first pupa observed	Maximum pupation	Approximate date last pupation
1926	June 16	June 21—July 1	July 22
1927	June 13	June 18—June 28	July 15
1928	June 11	June 19—June 28	July 12
1929	June 12	June 18—June 29	July 16

Winter Mortality. There is always a certain percentage of mortality of the larvae within the hibernacula during the winter months. Many factors are probably responsible for this larval mortality, such as low temperature, sudden change in temperature, humidity, fungous diseases, etc. Determination was made of the percentage of winter mortality covering a five year period beginning 1926, from several localities in the Annapolis valley. Many of the dead larvae were hard and mummi-

fied when these counts were made in April, others were of a more or less normal appearance and had apparently recently died. This winter mortality, although of great assistance in reducing the pest in numbers, falls far short of being adequate during an outbreak.

TABLE 10.—*Winter mortality of larvae of Spilonota ocellana, D. & S., 1927 to 1930.*

Year	Date counted	Locality	Larvae alive	Larvae dead	Percentage mortality
1926	April 30	Berwick	827	284	25.5
"	May 3	Paradise	85	29	25.4
1927	May 19	Annapolis Royal	354	18	5.0
"	May 26	Berwick	899	138	15.3
1928	April 2	Lakeville	164	24	12.7
"	April 2	Berwick	192	24	11.1
1929	April 11	Lakeville	335	147	30.5
"	April 24	Berwick	94	58	38.1
"	April 24	Lawrencetown	140	44	22.9
1930	April 17	Canard	153	16	9.4
"	April 17	Berwick	72	147	64.3
"	April 17	Paradise	149	49	24.7
"	April 17	Lawrencetown	292	76	20.6
"	April 17	Lakeville	182	178	49.4
"	April 17	Wilmot	143	54	27.4

DAMAGE CAUSED BY EYE-SPOTTED BUDMOTH

Losses resulting from budmoth attacks may be summarized as follows. (1) Bud injury in the spring. (2) Injury to the newly formed fruit. (3) Skeletonizing of the foliage at mid-summer and early fall. (4) Side injury to the maturing fruit.

In orchards with infestations such as existed in those where the data for table 8 were gathered, there must follow interference with normal development of leaf and blossom buds and a reduction in set of fruit. This spring injury, however, was found to vary one year with another. In 1926 the trees remained in bloom for a very short time and the injury was not at all pronounced. In the spring of 1927 the bloom remained upon the trees for a much longer period and the injury to the blossoms in reduction of set and injury to the newly set fruit was much more in evidence than the previous year. Undoubtedly severe losses have directly resulted, in the spring, from larval attacks, but on the other hand non-set of fruit has been attributed on many occasions to the eye-spotted budmoth, ignoring such factors as fertilization, scab, etc. Nurserymen also find the budmoth one of the most dreaded insects. The larvae hibernate about the incisions made when setting buds. In the following spring the newly set bud is entirely destroyed before opening, resulting in the entire loss of the tree in the nursery.

The amount of injury resulting from gnawing of the fruit shortly after setting is a variable factor. On account of the weakening of the fruit from the deep holes that are made, the majority drop prematurely. In the event, therefore, of a full set there may result only a slight thinning of the

fruit, which may be a benefit rather than a loss. On the other hand, with a light set, thinning may be a distinct loss. The injured surface of such fruit which remains upon the tree heals, but a deformity developes and the resulting scars at picking time resemble those caused by the green fruit worms.

During the years 1925-26-27, it was common for many orchards to suffer a loss of 50 to 75 per cent of their leaf area by late September, due to the skeletonizing of the foliage by the larvae previous to hibernating. There must follow a general reduction in vitality of the trees resulting in weak fruit buds from such a loss of the trees' main source for storing plant food for future fruit production. This injury as it affected the trees was seldom commented on by fruit growers, and the writer feels that its importance has not been fully realized.

The most evident loss resulting from budmoth attacks is the side injury to the fruit. This consists of shallow feeding on the fruit surface, and follows whenever infested foliage comes in contact with the fruit, or the larvae frequently crowd between two apples, both being injured. The resulting loss varies somewhat with the different varieties of apples as well as with the degree of budmoth infestation. During the recent budmoth outbreak in the Annapolis valley losses varied from 25 to practically 100 per cent of the fruit showing more or less scarring. Besides the direct side injury to the fruit the larvae frequently enter the calyx of the apple, where the accumulated frass retains moisture even during dry weather. This, together with a limited amount of skin feeding about the calyx, results in a very unsightly appearance to such affected fruit.

Ecological Factors

The evidence is conclusive, at least so far as Nova Scotia is concerned, that the eye-spotted budmoth is undoubtedly a pest of well cared for orchards and particularly of those in a thrifty vigorous condition. Apple trees growing in waste land or those in an otherwise neglected condition, even though adjacent to infested orchards, are not seriously attacked. This was especially in evidence in all parts of the Annapolis valley and particularly in the extreme western portion.

Orchards situated in exposed elevations were apparently as readily attacked as those in more protected situations. Concentration of orchard areas, however, is undoubtedly a factor which favors the increase of the insects in excessive numbers, and in such areas the pest is more difficult to bring under control.

Although perhaps not proven conclusively, it nevertheless seems apparent, that some of the methods of modern orcharding disturb the balance of natural control in relation to this insect and its environment, in such a way as to favor the increase of this pest. Even certain spray and dust programmes, in which special provision has not been made for budmoth control, seem to favor the insect. Dusting, either with sulphur or Bordeaux, and to a lesser degree spraying with Bordeaux mixture seems, in ways not understood, to have an adverse influence on natural control.

Parasites

Each year that this insect has been under study, parasites have been reared from the eye-spotted budmoth larvae. From most districts the numbers recovered were not great, but fewer parasites were obtained from orchards where spraying was a general practice than from orchards which received no treatment. At Berwick, in the centre of the Annapolis valley, where thorough spraying is in vogue, only a few parasites were obtained from larvae collected in this district. At Annapolis Royal, where probably not 10 per cent of the orchards are sprayed, a much larger proportion of the collected larvae were parasitized. The parasites included both dipterous and hymenopterous species, which have not been identified. There were at least two parasites worthy of special mention. When examining budmoth hibernacula during the latter part of the winter a small number were found occupied by a single parasite. In April all that remained of the hibernating larvae were the cast heads. The insect, however, had not been sufficiently affected the previous autumn to prevent it constructing a normal hibernaculum and the parasite had lived and developed upon its body, being provided at the same time with comfortable winter quarters. Strangely, although these parasites were fully developed in April, the adults did not emerge until the end of July and during August. By that time the following generation of budmoth larvae had appeared thus probably eliminating the necessity for a second host to complete the yearly cycle. These parasites were very minute and included at least two hymenopterous species, neither of which have been definitely determined.

In 1926 a few egg parasites were observed. In the following year this egg parasite was very prevalent and in order to obtain an accurate estimate of the percentage of parasitism, counts were made in several areas.

The parasitized eggs turn black and are, therefore, readily recognized from normal eggs. It was common to find two of these minute parasites developing and emerging from a single budmoth egg. This parasite, identified as *Trichogramma minutum* Riley, was prevalent over the entire budmoth infested area in 1927, and the mortality from this source alone was of great assistance in affecting a reduction of the pest. It seems somewhat strange that this parasite did not persist. However, in both 1928 and 1929 it was only observed in very small numbers, in fact it could scarcely be found in most orchards.

Table 11.—*Percentage of eggs parasitized of Spilonota ocellana, D. & S., 1927-28.*

Locality	Date	Number of leaves	No. of eggs counted	No. of eggs parasitized	Percentage
Berwick	Aug. 5, 1927	873	4000	1260	31.5
Lakeville	Aug. 8, 1927	946	3000	360	12.3
Starr's Point	Aug. 11, 1927	1741	3400	755	22.2
Paradise	Aug. 20, 1927	980	3200	601	18.8
Lakeville	July 29, 1928	1091	2000	29	1.45
Paradise	July 29, 1928	987	2000	52	2.6

The Eye-spotted Budmoth in Relation to Orchard Insects

As stated previously, the larvae of the eye-spotted budmoth in the spring tie the leaves and blossoms together in small bunches. These are largely deserted at the end of June, but these shelters remain upon the trees, at least in part, for some time. They consist of partly consumed leaves, portions of which may be dead, together with damaged or abortive blossoms and their dried out petals. Shortly after these shelters are deserted by the eye-spotted budmoth, the larvae of another group of insects commonly referred to as leaf rollers, are making their appearance in the orchard. The newly hatched larvae of a few species of these leaf rollers enter these deserted shelters which they further secure to the trees by additional silk. The larvae of *Archips rosaceana* Harris, *Cacoecia persicana* Fitch, *Pandemis limitata* Rob., and *Tortrix afflictana* Wlk., are practically dependent upon some such prepared shelters in their early instars. In the years 1925 to 1927 the first three species mentioned became quite prominent in many parts of the worst infested eye-spotted budmoth orchards. So marked was this increase in some districts that fears were entertained that these insects might assume the role of major orchard pests. Since 1926 the downward swing of the cycle in relation to *Spilonota ocellana* D. & S. has been in progress. By the summer of 1930 the eye-spotted budmoth had so diminished in numbers in the Annapolis valley that few growers found special control measures necessary. At the same time these so-called newer insect pests have likewise diminished in numbers in much the same ratio, and they will probably remain obscure until another epidemic of *S. ocellana*.

Plate 1.

Eye-spotted budmoth, *Spilonota* D. & S.

1. Lateral view of head capsule.
2. Dorsal view of head capsule.
3. Venation of wings of male moth.
4. Pupa, male, dorsal view.
5. Pupa, male, ventral view.

EXPLANATION OF SYMBOLS APPLIED TO PUPA

a—antenna; a, 1 to 10—abdominal segments; ao—anal opening; cl—clypeus; cx2—coxa of the mesothoracic leg; f—front; f1—femur of prothoracic leg; go—genital opening; lb—labrum; l1—prothoracic leg; l2—mesothoracic leg; l3—metathoracic leg; lp—labial palpi; md—mandibles; mp—maxillary palpus; ms—mesothorax; mt—metathorax; mx—maxilla; p—prothorax; v—vertex; w1—mesothoracic wing; w2—metathoracic wing.

EXPLANATION OF SYMBOLS APPLIED TO HEAD

A1, A2, A3, Aa—setae and puncture of anterior group of epicranium; Adf1, Adf2, Adfa—adfrontal setae and puncture of epicranium; ADFR—adfrontal ridge of larval head; ADFS—adfrontal suture of larval head; E1, E2—epistomal setae; F1, Fa—frontal setae and puncture of epicranium; FR—frons of epicranium; G1, Ga—genal setae and puncture of epicranium; L1, La—seta and puncture of lateral group of epicranium; LR—Longitudinal ridge of epicranium; O1, O2, O3—setae of ocellar group of epicranium; P1, P2, Pa, Pb—setae and punctures of posterior group of epicranium; SO1, SO2, SO3, SOa—setae and puncture of subocellar group of epicranium; X—ultra posterior setae and puncture of epicranium.

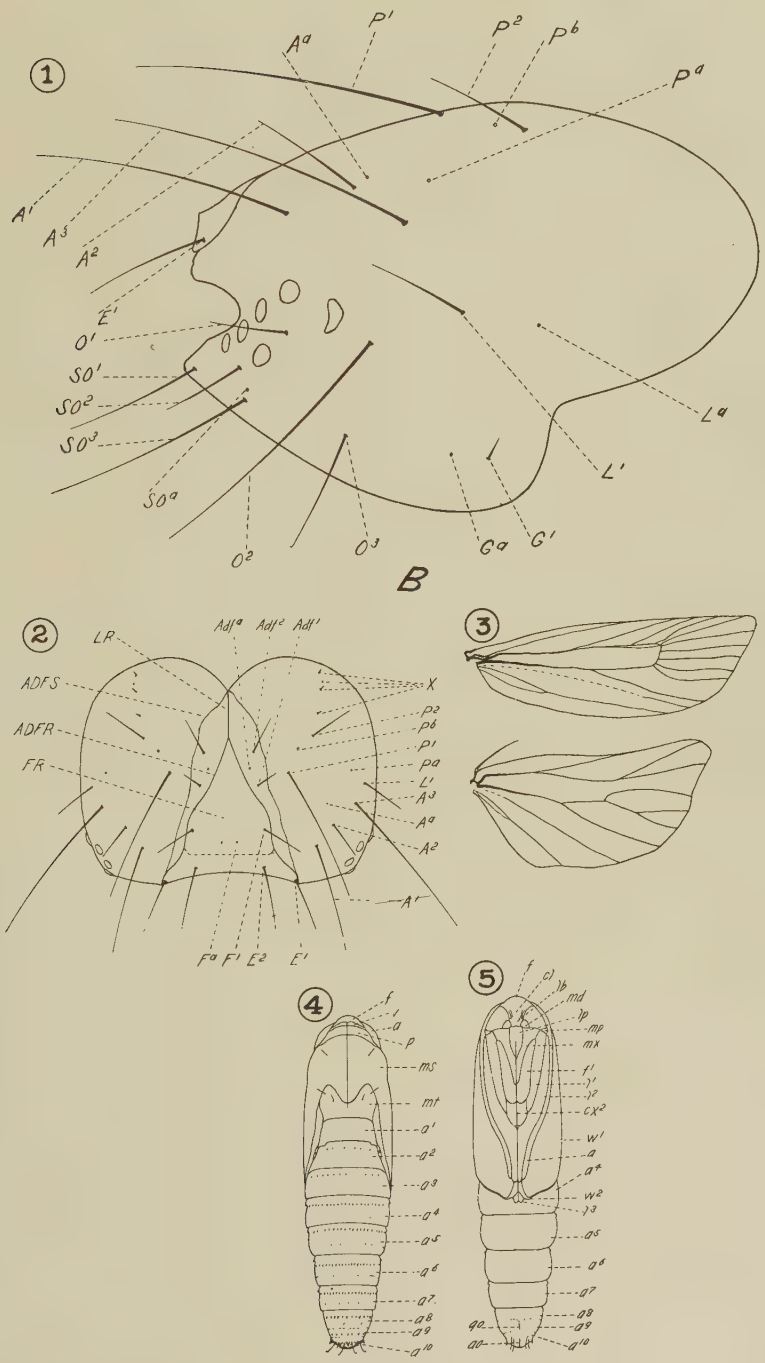

Plate 1.

(See foot of opposite page for explanation.)

Plate 2.

1. Infested apple blossom cluster.
2. Adult moths male and female.
3. Mature fruit showing the resulting scars produced by the spring feeding of the larvae.
4. Twig showing bud development at time of larval emergence from hibernacula.
5. Hibernaculum opened to show larva within.

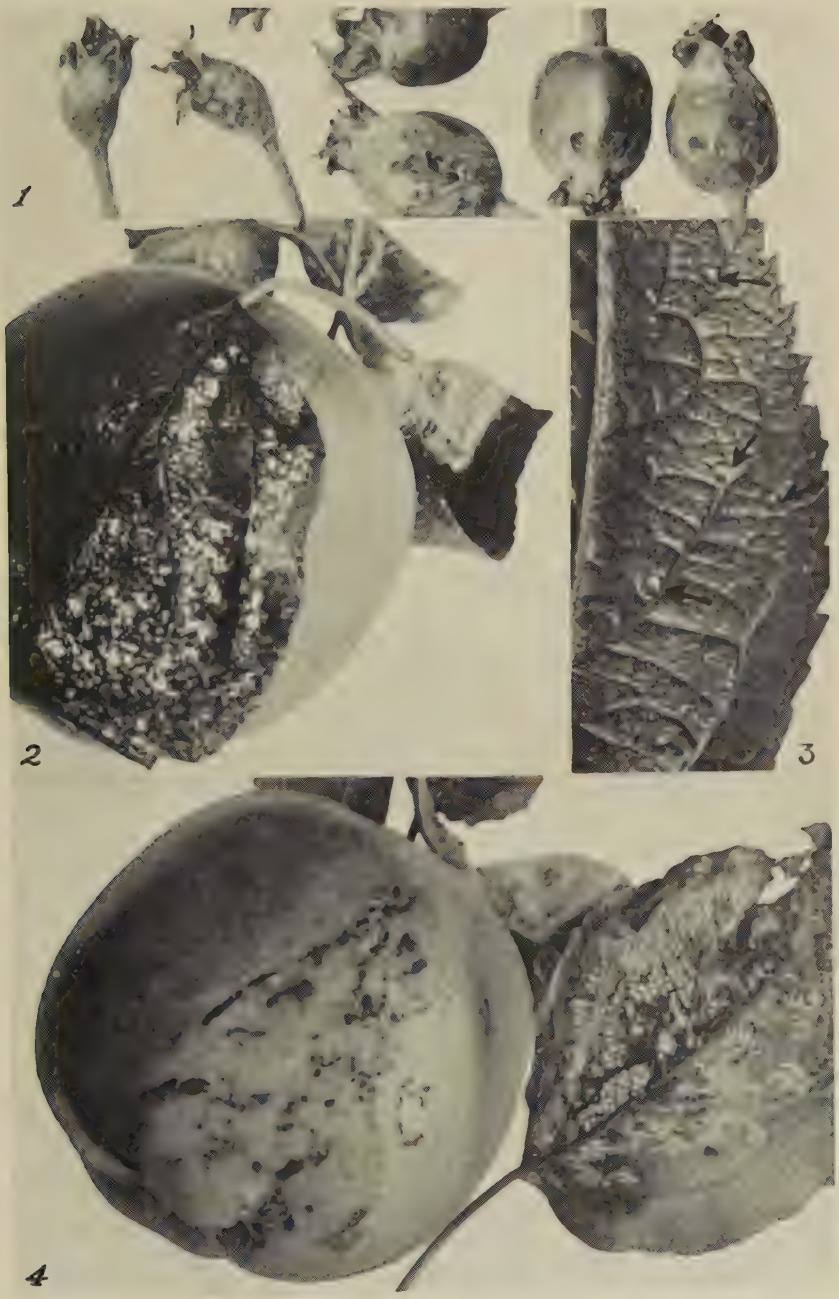

Plate 3.

1 Newly formed fruit injured by the larvae.
2 An apple showing how the leaves are tied to the fruit by the larvae previous to hibernating.
3 Eggs on under surface of a leaf.
4 Same as figure 2, with leaf removed showing the fruit injured beneath. This also indicates how the foliage is skeletonized during early fall.

THE OPTIMUM RATIOS OF THE DISTRIBUTION OF THE THREE FACTORS OF PRODUCTION ON POULTRY FARMS OF BRITISH COLUMBIA.

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INTRODUCTION

It is obvious that to produce efficiently, the three factors of production (land, labour and equipment) must be properly coördinated and not simply combined in any careless way.

The following article is an attempt at a practical application of the knowledge of the law of variable proportions to given agricultural enterprises, that is, it is an attempt to find out the optimum ratios of the distribution of the three factors of production for the poultry farms of British Columbia.

There are two possible ways of attacking the problem: (1) the optimum ratios could be found by experimenting. Experimental poultry farms, each with a different combination of the three factors of production, could be organized and the results of their productive activities could be compared. (2) The optimum ratios could be found by analyzing the existing poultry farms. The poultry farms could be surveyed, classified according to the portions of their total investment in the different elements of production, and the results of the productive activities of the different classes of farms then compared. In this paper, the second method has been used.

METHOD OF INVESTIGATION EMPLOYED

Material obtained from the Farm Survey conducted by the Faculty of Agriculture of the University of British Columbia is the statistical basis for this study. As the basis for this article, the data concerning 67 poultry farms of the Lower Fraser Valley district, and the Duncan district on Vancouver Island have been used. These farms as a rule are highly specialized enterprises and their success and the type of their organization does not depend to any great extent on the slight variations in the climatic conditions and the soil fertility. As far as poultry farming is concerned, both the Duncan district on Vancouver Island and the Lower Fraser Valley district may be considered as providing equal opportunity for carrying on the business under consideration. The market for poultry products is very much the same in both districts.

It is assumed that the optimum combination of the factors of production is one which yields the largest "operator labour income". The operator labour income represents the farm net revenue less 7 per cent interest on investment in land, buildings, machinery, livestock, and feed and supplies. "Farm net revenue" is the difference between gross receipts and gross expenses. Therefore, the operator labour income represents the farm

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operator's return for his labour and for his managerial ability. When the interest on the investment exceeds the farm net revenue, the difference becomes a minus operator labour income.

It is assumed that the prices of different products and of the different elements of production are not subject to permanent changes.

It is assumed also that the size of an agricultural enterprise is determined by the total farm investment. In total investment are included all the owned, rented and borrowed elements of production. More precisely, the total investment includes the value of:

(1) The land
(2) The labour
(3) The machinery
(4) The livestock
(5) The farm buildings
(6) The feed and supplies
(7) The cash invested
(8) The house

As a first step in the investigation, each one of the 67 poultry farms was carefully analyzed. The total capitalization, operator labour income and the percentage of the total capitalization invested in land, in labour and in equipment were calculated. In order to obtain the percentages, the absolute figures representing the investments in the different factors of production had to be considered first. The figure resulting from the subtraction of the sum of values of land plus labour from the value of the total capitalization, was considered as the absolute value of the investment in equipment.

TABLE 1.—*Classification of poultry farms studied.*

Group	Total Capitalization per Farm	Number of Farms	No. of sub-marginal Farms	Percentage of sub-marginal Farms
I	$ 4,000 - 5,550	5	2	40
II	5,550 - 9,000	30	1	3.3
III	9,000 - 16,000	21	2	9.5
IV	16,000 - 26,000	11	2	18.2

The farms were divided into four size groups, the limits of these groups being determined, of necessity, more or less arbitrarily. The farms which had an operator labour income of above plus $600.00 are termed "above-marginal farms"; those which had an operator labour income of from "0" up to plus $600.00 are termed "marginal farms"; and those which had a minus operator labour income are called "sub-marginal farms".[2]

Poultry Farms of Group I.

TABLE 2.—*Average percentage distribution of the three factors of Production.—Group I.*

	Land	Labour	Equipment
Above-Marginal Farms	—	—	—
Marginal Farms	19.8	13.1	67.1
Sub-marginal Farms	36.8	12.1	51.1

[2]This does not mean that these farms are actually marginal or sub-marginal. It must be remembered that 7 per cent interest on investment has been deducted from the farm net revenue.

There were no above-marginal farms in the first group; no one of the enterprises showed more than $600.00 operator labour income. The more successful farms had much smaller proportions of their total capitalization invested in land. They had larger proportions invested in equipment.

In order to be able to determine what percentages of the total capitalization should be invested in land, and what percentages should be invested in labour, and what percentages should be invested in equipment, the farms of the size group were classified according to the percentages of the investment in the different elements of production. The farms were divided into sub-groups according to the percentage of the investment in land. A 10 per cent interval was adopted, so that in the first sub-group are included the farms which had from 10 per cent up to 20 per cent of their total capitalization invested in land; in the second sub-group, the farms which had from 20 per cent to 30 per cent of their total capitalization invested in land, and so on. The farms were then divided into sub-groups according to the percentage of their total capitalization represented by labour. A 2 per cent interval was adopted for labour. The farms were further divided into sub-groups according to the percentage of their total capitalization invested in equipment. A 10 per cent interval was adopted for equipment.

TABLE 3.—*Poultry survey, 1924.—Group I.*

Percentage of investment in land, labour, and equipment.		Percentage of farms in the sub-group to the total number of farms in the size group.	Percentage of sub-marginal farms in sub-group to total number of farms in the same sub-group.	Average operator labour income for each sub-group
Land:	10 to 20	20	0	$492.54
	20 to 30	60	33.3	258.68
	30 to 40	20	100	−60.60
Labour:	9 to 11	20	100	−60.60
	11 to 13	40	0	424.34
	13 to 15	40	50	210.00
Equipment:	40 to 50	20	100	−60.60
	50 to 60	40	50	210.00
	60 to 70	20	0	356.13
	70 to 80	20	0	492.54

The bulk of the farms of the first group had from 20 per cent to 30 per cent of their total capitalization invested in land. The tendency to have more land than is justified by the available equipment is plainly seen. The farms which had the lowest percentages invested in land yielded the largest operator labour incomes. Also there was a lower percentage of failures in this group.

The majority of the farms had from 50 per cent to 60 per cent of their total capitalization invested in equipment; about one-half of such farms were sub-marginal. The tendency to be short of equipment seems to be general. The farmers who had the larger share of their total capital invested in equipment had the larger incomes.

It would appear that the farmers of the first size group should endeavour to increase their investment in equipment.

Poultry Farms of Group II.

The majority of the poultry farms belong to the second size group, namely, to the group which includes the farms with the total capitalization of from $5,550.00 to $9,000.00.

Table 4.—*Average percentage distribution of the three factors of production.—Group II.*

	Land	Labour	Equipment
Above-marginal Farms	20.2	8.9	70.9
Marginal Farms	28.3	11.9	59.8
Sub-marginal Farms....	24.2	7.2	68.6

In the second size group only one sub-marginal farm was found. Consequently, the "averages" for the sub-marginal farms of the second size group cannot be considered as being fairly representative. The more remunerative poultry farms of the second size group had a much smaller proportion of their total capitalization invested in land. They had a greater proportion of their total capitalization invested in equipment. The differences in the amounts of the investments in labour did not seem to influence the returns very much.

More detailed information can be obtained from the following table.

Table 5.—*Poultry survey, 1924.—Group II.*

Percentage of investment in land, labour, and equipment.		Percentage of farms in the sub-group to the total number of farms in the size group.	Percentage of sub-marginal farms in sub-group to total number of farms in the same sub-group.	Average operator labour income for each sub-group
Land:	Less than 10	10.0	0	$1716.51
	10 to 20	46.7	0	1171.93
	20 to 30	26.7	12.5	1509.19
	30 to 40	10.0	0	754.57
	40 to 50	6.6	0	834.01
Labour:	7 to 9	63.3	5.3	1338.55
	9 to 11	20.0	0	1525.29
	11 to 13	10.0	0	589.89
	15 to 17	3.3	0	1191.60
	17 to 19	3.4	0	16.28
Equipment	40 to 50	10.0	0	612.81
	50 to 60	10.0	0	929.02
	60 to 70	23.3	14.3	1002.92
	70 to 80	46.7	0	1482.10
	80 to 90	10.0	0	1722.13

The fact may be noted that the farmers of the second size group might give somewhat more detailed attention to their flocks. Sixty-three and three-tenths per cent of all the farmers had invested in labour from 7 per cent to 9 per cent of the total capitalization of their enterprises. The next group of the farmers who had a somewhat larger share of their total capitalization invested in labour, namely, from 9 per cent to 11 per cent, obtained a somewhat larger operator labour income.

The best proportions for the different factors of production for the poultry farms of the second size group seem to be around 10 per cent in land, 10 per cent in labour and 80 per cent in equipment.

Poultry Farms of Group III.

Table 6.—*Average percentage of distribution of the three factors of production.—Group III.*

	Land	Labour	Equipment
Above-marginal Farms	21.0	7.5	71.5
Marginal farms	37.5	6.3	56.2
Sub-marginal farms	16.2	8.5	75.3

In this group there were only two sub-marginal farms, consequently averages for sub-marginal farms are not reliable. Comparing the above-marginal farms with the marginal, it is clear that the more profitable farms had less land and more equipment than the less profitable farms. The above-marginal farms had a little larger share of their total capitalization invested in labour. The following table gives the information in detail.

Table 7.—*Poultry survey, 1924.—Group III.*

Percentage of investment in land, labour, and equipment.		Percentage of farms in the sub-group to the total number of farms in the size group.	Percentage of sub-marginal farms in sub-group to total number of farms in the same sub-group.	Average operator labour income for each sub-group
Land:	10 to 20	38.1	12.5	$1547.63
	20 to 30	47.6	10.0	1416.98
	30 to 40	4.8	0	445.07
	40 to 50	9.5	0	295.34
Labour:	3 to 5	9.5	0	382.15
	5 to 7	38.1	0	1602.09
	7 to 9	33.3	28.6	1152.75
	9 to 11	14.3	0	1562.12
	11 to 13	4.8	0	1250.05
Equipment:	40 to 50	4.8	0	304.71
	50 to 60	9.5	0	365.52
	60 to 70	38.1	0	1555.82
	70 to 80	47.6	20.0	1410.42

The largest number of the poultry farms of the third size group had from 20 to 30 per cent of their total capitalization invested in land. The farms which had from 10 to 20 per cent of their total capitalization represented by land returned larger operator labour incomes.

Poultry Farms of Group IV.

Table 8.—*Average percentage of distribution of the three factors of production.—Group IV.*

	Land	Labour	Equipment
Above-marginal Farms	17.3	7.6	75.1
Marginal Farms	33.0	6.0	61.0
Sub-marginal Farms	48.0	7.9	44.1

Just as in the case of the previously considered groups, it can be seen that the most profitable farms had the smallest share of their total capitalization invested in their land. The largest share of the total capitalization of the most profitable farms was represented by equipment.

TABLE 9.—*Poultry survey, 1924.—Group IV.*

Percentage of investment in land, labour, and equipment.	Percentage of farms in the sub-group to the total number of farms in the size group.	Percentage of sub-marginal farms in sub-group to total number of farms in the same sub-group.	Average operator labour income for each sub-group
Land: Less than 10	18.1	0	$2867.43
10 to 20	36.5	0	2094.10
20 to 30	9.1	0	992.23
30 to 40	18.1	0	561.68
40 to 50	9.1	100	−396.96
50 to 60	9.1	100	−63.96
Labour: 3 to 5	9.1	0	955.34
5 to 7	27.2	0	606.20
7 to 9	54.6	33.3	1854.29
11 to 13	9.1	0	1866.26
Equipment: 30 to 40	9.1	100	−63.96
40 to 50	9.1	100	−396.96
50 to 60	9.1	0	955.34
60 to 70	18.2	0	580.13
70 to 80	27.3	0	2050.09
80 to 90	27.2	0	2653.67

The bulk of the farms of the fourth size group had from 10 per cent to 20 per cent of their total capitalization invested in land. The farms which had less invested in land had larger operator labour income; the farms which had larger land investment yielded their operators smaller operator labour incomes. With the increase of the proportion of the total capitalization invested in equipment, the operator labour income increased. The farms which had less than half of their total capitalization represented by equipment yielded minus operator labour incomes. The bulk of the farms had from 5 per cent to 9 per cent of their total capitalization invested in labour. The optimum proportions of the investment in the three factors of production seem to be as follows; 10 per cent in land, 10 per cent in labour and 80 per cent in equipment.

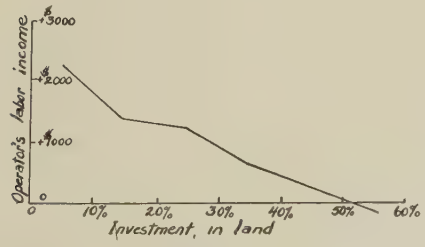

Figure 1.

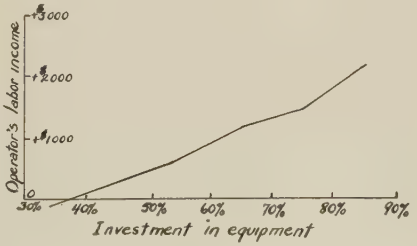

Figure 2

Figure 1. Correlation of the percentage of the total capitalization of farms invested in land—and the operator's labor income.

Figure 2. Correlation of the percentage of the total capitalization of farms invested in equipment—and the operator's labor income.

TABLE 10.—*Correlation of the percentage of the total capitalization of the farms invested in land or in equipment—and the operator labour income.—Poultry Survey, 1924.*

Per cent of the total capitalization of farms invested		Number of farms in the sub-group	Average operator labour income
In land:	up to 10	5	$2,284.38
	10 to 20	26	1,400.99
	20 to 30	22	1,273.26
	30 to 40	7	646.56
	40 to 50	6	300.19
	50 to 60	1	−63.96
In equipment:	30 to 40	1	−63.96
	40 to 50	6	280.93
	50 to 60	8	611.67
	60 to 70	18	1,165.75
	70 to 80	28	1,482.02
	80 to 90	6	2,188.23

The writer is aware of two weaknesses in this paper: (1) The number of farms included in the study is not large. Though this be true, the fact that all the figures point in the same direction indicates that the findings are sound in principle. (2) Too many different items were included in the one factor of production, namely, the equipment. The investments in buildings, machinery, livestock, feed and supplies, and in cash used for current expenses were included in equipment. Different farms had different percentages of their total investment in equipment represented by livestock, machinery, or buildings. This variation does not permit of absolute accuracy in the comparisons of the differences in investment in equipment. The same percentage of the investment in equipment may mean different things.

SUMMARY

(1) The apparent optimum proportions of the investment in the different factors of production were approximately the same for farms of all sizes; i.e. 10 per cent in land, 10 per cent in labour, and 80 per cent in equipment.

(2) A large number of farms had too large a proportion of their total investment in the land.

(3) Many farms used an insufficient amount of labour.

(4) There was no indication that the point of diminishing returns had been reached.

(5) There was a greater number of failures among large farms than small farms.

(6) Since 40 per cent of the farms under $5,500.00 capitalization are sub-marginal, it would seem that this amount is the least total capital that should be used.

ACKNOWLEDGMENT

The writer takes this opportunity of expressing his sincere thanks and gratitude to Professor H. R. Hare for his kind advice and to F. M. Clement, Dean of the Faculty of Agriculture of the University of British Columbia, who made possible this investigation.

APERCUS NOUVEAUX EN INDUSTRIE LAITIERE [1]

Dr. J. M. Rosell [2]
Institut Agricole d'Oka

L'avenir de la santé est dans les laits transformés.

On m'a demandé à titre de bactériologiste en industrie laitière de venir vous entretenir d'un sujet que l'on pourrait intituler: "Aspects nouveaux en industrie laitière", ou bien encore, "Nouvelles industries dérivées du lait".

Dr. J. M. Rosell

Dans tous le pays à civilisation avancée, l'Industrie laitière est considérée de toute première importance tant à cause des profits qui en dérivent qu'à cause et surtout de ses relations avec la santé.

Les hygiénistes admettent que la majorité de l'humanité ne sait pas se nourrir. Les maladies digestives et autres trouvent leur origine dans une nourriture inadéquate tant chez les enfants que chez les adultes. Mentionnons comme l'une des défectuosités les plus répandues de notre alimentation présente le déséquilibre existant, tant au point de vue quantitatif que qualitatif, entre les principes nutritifs composant les régimes alimentaires. Il n'y a pas que les animaux de la ferme qui soient soumis à des rations mal balancées ou mal équilibrées; les hommes aussi le sont, peut-être à un degré plus marqué encore. La conséquence inévitable de ces régimes incomplets, c'est l'affaiblissement de la santé et de la vitalité. Or, le grand correctif alimentaire et le plus économique, c'est le lait avec ses dérivés. Si 10,000,000 de pintes de lait étaient consommées chaque jour par les habitants du Canada, la santé, la puissance et la vitalité de la population augmenteraient de jour en jour, d'année en année, de génération en génération. Les maladies diminueraient en une proportion peut-être difficile à établir, mais sûrement en un proportion considérable. Je parle ici comme médecin, qui depuis plus de 25 ans étudie et observe les rapports existant entre la santé des hommes et la consommation du lait. Au cours des périodes de l'antiquité, la médecine d'alors tenait le lait comme l'un des aliments les plus précieux qui soient. La médecine moderne, non seulement a retenu cette opinion des anciens, mais la présente aujourd'hui à la lumière des dé-

1. Conférence faite à Québec le 20 janvier 1932, lors du diner-causerie annuel de la section québecoise de la C.S.T.A.

2. Dr. José-Maria Rosell, biologiste, analyste de réputation mondiale, diplômé de l'université espagnole de Barcelone; élève et professeur à l'université suisse de Berne; docteur "cum magna laude" à l'université allemande de Wurzberg; docteur de laboratoire à Thionville, Lorraine, France; bactériologiste à l'Institut Impérial Tropical de Hambourg; organisateur et directeur d'Instituts de produits laitiers dans plusieurs pays, notamment en Espagne, en Allemagne et aux Etats-Unis; décoré du prix Blondet, avec titre de lauréat de l'Académie de Médecine de Paris en 1930; auteur de plus de 80 ouvrages scientifiques; considéré par l'Encyclopédie universelle "Europe-Amérique", comme l'un des médecins et analystes les plus reconnus de l'Espagne; professeur de bactériologie à l'Institut Agricole d'Oka depuis 1929.

couvertes scientifiques comme un dogme. Elle déclare en effet qu'il n'y a pas d'autre aliment dans la nature qui soit aussi complet, aussi bienfaisant que le lait, pour le maintien de la santé de l'homme.

Dans tous les pays, pourrait-on dire, les chefs sont conscients de cette vérité. Aussi, avisent-ils aux meilleurs moyens à prendre pour amener une plus grande consommation du lait et de ses dérivés et pour maintenir l'industrie laitière dans un état constant de progrès.

Malheureusement, cette industrie si importante pour la santé de l'homme est sujette, comme toutes ses soeurs, à l'action des forces économiques. C'est peut-être, à l'heure présente, de toutes les industries de la terre, la plus fortement soumise à la loi de la concurrence sur les grands marchés internationaux. Or, les fortes concurrences étrangères, parce que tendant à l'avilissement des prix, tendent à décourager les producteurs, qui y sont mal préparés, et tendent en conséquence à compromettre la vie de cette importante industrie. Comment peut-on réagir contre une force économique aussi néfaste? Que fait-on à ce sujet dans les pays producteurs de lait? Que fait-on? Ceci:

1.—Aux forces économiques qui tendent à diminuer les exportations de beurre et de fromage sur les grands marchés internationaux, on oppose la qualité supérieure des produits exportés, qui leur font encore trouver preneur dans une mesure parfois limitée sans doute, mais encore satisfaisante.

2.—Aux mêmes forces économique qui tendent à encombrer de beurre et de fromage les marchés nationaux, on oppose la création de produits laitiers nouveaux, lesquels, en variant l'offre des produits laitiers, en stimulant la demande, décongestionnent, dans une mesure appréciable, le marché local et augmentent sa puissance d'absorption.

En d'autres termes, on améliore par tous les moyens scientifiques disponibles la qualité des produits laitiers exportables: beurre, fromage, de façon à ce qu'ils perdent le moins de terrain possible à l'étranger, et, pour faire contrepoids aux diminutions inévitables dans les exportations de ces mêmes produits et à leur accumulation sur le marché national, on relève le potentiel d'absorption du marché local en créant des dérivés laitiers nouveaux, qui transformeront le lait en des produits laitiers nouveaux, destinés avant tout à la consommation locale.

Ces produits laitiers nouveaux, de même que les procédés modernes fabrication du beurre et du fromage, constituent des aspects nouveaux de l'industrie laitière moderne.

Grâce au développement scientifique en industrie laitière, grâce tout particulièrement au développement de la bacteriologie laitière, on a pu, en ces dernières années, développer et commercialiser sept types nouveaux de produits laitiers, dont la valeur marchande s'élève à plusieurs centaines de millions de dollars. Ces produits laitiers nouveaux se fabriquent sur Autriche, en Suisse, en Hollande, au Danemark, en Espagne, en Italie et dans les Pays balkaniques. Bien que ces produits laitiers nouveaux constituent un moyen de raffermir les bases économiques de l'industrie laitière, leur importance dépasse de beaucoup leur valeur argent à cause de

leur influence reconnue par les meilleures autorités médicales sur la santé de l'homme et des animaux. Je retiendrai les produits suivants:

1.—Lait maternisé ou humanisé.

2.—Lait yoghuré.

3.—Lait acidophilé.

4.—Lait champagnisé.

5.—Laits médicaux divers.

6.—Boissons lactées rafraîchissantes.

7.—Produits lactiques yoghurés pour les animaux de la ferme.

1.—Lait Maternise

Dans tous les pays du monde, on s'efforce, et avec combien de raison, de réduire le fléau de la mortalité infantile. Or, c'est l'allaitement artificiel qui, dans toutes les contrées de la terre, a été reconnu comme l'une des premières causes de la mortalité infantile. Cependant, l'allaitement artificiel est malheureusement un mal inévitable pour des raisons que nous n'avons pas le temps d'étudier ici. Cette fatalité, admise comme insurmontable par les hommes de science, les a poussés à rechercher quel serait le substitut chimiquement, physiquement et biologiquement apte à remplacer avec le minimum d'inconvénients le lait maternel. Le problème est difficile à résoudre parce qu' excessivement complexe et pour ne signaler que le pire des obstacles, mentionnons le plus important, celui de l'infection. Plus d'un substitut a été inventé pour remplacer le lait maternel. Nous n'en connaissons pas de meilleur que celui appelé "Lait maternisé ou humanisé" dont voici la définition.

Le lait maternisé, c'est du lait de vache provenant de troupeaux sains, surtout exempts de tuberculose et de mammite infectieuse, dilué avec de l'eau ou des décoctions spéciales proportionnellement à l'âge de l'enfant, additionné de lactose et se sels minéraux, aux fins de corriger sa teneur en caséine, en albumine, en sucre et en sels minéraux, de manière à le rendre le plus chimiquement semblable au lait maternel; additionné de vitamines particulièrement sous forme de jus d'orange, de citron ou de tomate; traité bactériologiquement avec des bactéries lactiques thermophiles favorables à la santé et résistant à la chaleur de la pasteurisation. Ce lait maternisé est pasteurisé en biberons formés de façon à prévenir tout danger de réinfection à la suite des manipulations et à une température qui détruise tous les germes pathogènes, mais sans trop altérer les qualités biologiques.

Le grand avantage du lait maternisé, pasteurisé en bouteilles, c'est qu'il réduit au minimum les chances de contamination après la pasteurisation. En effet, ce lait étant offert en vente en biberons gradués d'après l'âge de l'enfant, la mère n'a pas à lui faire subir des transvasements dangereux. Quant vient le moment de le faire prendre à l'enfant, on réchauffe le biberon dans de l'eau chaude, on enlève rapidement la capsule qui le ferme et on y adapte alors la tétine préalablement ébouillantée.

Ce lait qui se répand de plus en plus en Europe est offert en vente dans des paniers de 6 biberons, soit par les compagnies qui distribuent le lait à domicile, soit par les épiciers ou par certains établissements spéciaux. Après avoir constaté son efficacité dans d'autres pays, je l'ai moi-même

fait essayer en Espagne, à Barcelone, en 1917, et le succès qu'il a obtenu dans les maternités aussi bien que dans les familles a été des plus éclatants tant au point de vue de la diminution de la mortalité infantile que de l'amélioration dans l'état général de la santé des enfants. Eu égard à sa valeur chimique et biologique, et à son excellent état hygiénique, nous n'hésitons pas à dire que le lait maternisé et pasteurisé en bouteilles est appelé à un développement considérable.

2.—Le Lait Yoghure

C'est un lait entier, pasteurisé, généralement concentré aux trois-quarts de son poids par évaporation et spécialement traité bactériologiquement avec trois types de bactéries lactiques et transformé en un produit hautement digestible et nutritif, parfaitement agréable au goût, possédant en plus des propriétés médicales spéciales bien établies et reconnues. C'est l'aliment par excellence des estomacs délicats. En raison de sa teneur bactériologique, le yoghourt est surtout recommandé aux personnes souffrant de troubles intestinaux et spécialement d'intoxication. Le yoghourt est donc un aliment qui possède la double propriété de nourrir et de guérir certaines maladies digestives. Le yoghourt peut être offert en vente liquide ou semi-solide. C'est généralement sous la forme d'un caillé épais qu'on le fabrique. Il est présenté dans des pots spéciaux d'une capacité approximative d'un demiard. Il peut être sucré et essencé selon les goûts. Il jouit en Europe tout particulièrement en France, en Allemagne, en Suisse, en Autriche et dans les Pays balkaniques d'une vogue extraordinaire. Introduit depuis quelques années aux Etats-Unis, il vient de faire son apparition à Montréal et est déjà, me dit-on, en bonne demande. Nous ferons au sujet de cet important produit laitier d'autres considérations dans les lignes qui vont suivre.

3.—Lait Acidophyle

C'est généralement du lait écremé, stérilisé d'abord, puis traité bactériologiquement avec le bactérium acidophyllum, qui le transforme en une boisson crémeuse semblable au yoghourt liquide, mais beaucoup moins savoureuse que le yoghourt. Bien que de digestion facile et très nutritif, il est médicalement inférieur au yoghourt. Le lait acidophylé est répandu aussi en Europe, mais il jouit d'une plus grande popularité aux Etats-Unis. Il a été introduit depuis peu de temps à Montréal par la laiterie Elmhurst qui en fait déjà un débit appréciable. Il se vend en bouteilles d'une chopine ou d'une pinte. Il peut être aromatisé ou essencé selon les goûts.

4.—Le Lait Champagnise ou Kephyr

C'est du lait partiellement écremé, stérilisé et traité ensuite bactériologiquement: d'abord avec deux types de levures puis avec deux bactéries lactiques, vivant en symbiose, ferments qui le transforment en une boisson légèrement mousseuse et alcoolique. Grâce à l'action des microbes, ce lait champagnisé est extrêmement digestible, et défie les estomacs les plus délabrés. Le lait champagnisé ou "Képhyr" se vend en bouteille d'une capacité semblable à celles en usage dans le commerce des "liqueurs douces". Dans la partie centrale et orientale de l'Europe surtout, on en consomme une quantité considérable. Les trois types de lait que nous venons de décrire, savoir: le lait yoghuré, la lait acidophylé et le lait

champagnisé, sont tous des laits transformés sous l'action de bactéries spécifiques.

Comme ces laits ont une importance considérable en diétique moderne, qu'on me permettre donc à leur sujet quelques considérations d'ordre historique.

Si nous étudions l'histoire de l'alimentation humaine à travers lee différents âges de l'humanité, nous constatons le fait surprenant que voici. Les peuples anciens connaissaient et utilisaient de nombreuses variétés de lait et de façon beaucoup plus avantageuse que les peuples civilisés de notre siècle. Les peuplades nomades de l'Europe occidentale, les peuples bergers de l'Asie, de l'Europe balkanique, caucasienne et orientale, les tribus de l'Afrique du Nord et nombre des habitants des pays septentrionaux du globe terrestre, savaient que la valeur du lait se trouve fortement augmentée pour la digestion, le goût et la santé, après lui avoir fait subir un certain procédé de fermentation et d'aigrissement; cette connaissance, chaque peuple semblait l'avoir acquise par héritage traditionnel. Près de 50 types de lait fermenté, désignés chacun d'un nom spécial, sont décrits dans les traités nous renseignant sur les habitudes des peuples anciens. Dans une publication médicale sur ce sujet, je citais les noms donnés à ces laits transformés et certaines de ces appellations sont tout à fait symboliques. Le nom égyptien du lait fermenté "Laben" veut dire "Boisson de la vie". Képhyr, nom arabe, est employé pour désigner le lait champagnisé et signifie "Boisson de bien-être". Yoghourt, terme bulgare, signifie "de digestion facile".

Selon la tradition, Abraham semble avoir été le premier homme à préparer le yoghourt dont il avait appris par un ange la fabrication qu'il a transmise à sa descendance. Mahomet enseigna à son peuple la confection du képhyr, champagne de la vie, et les ferments qui servaient à le fabriquer étaient appelés "ferments du Prophète". Il était admis chez les peuples anciens que la fermentation des laits de chèvre, de chameau, de renne ou de jument les rendaient plus hygiéniques, plus agréables et surtout plus faciles à conserver.

Permettez-moi de vous rappeler ici un trait de l'histoire de François 1er, roi de France. Ce monarque, prématurément âgé, était très malade. Les médecins de la Cour désespéraient de le sauver. On appela à Paris certain médecin turc renommé à Constantinople pour ses cures merveilleuses. Il ordonna un long traitement avec du lait de chèvre transformé qu'il avait apporté avec lui et qu'il continua de préparer en secret dans la suite. C'était du yoghourt. L'histoire nous rapporte que le roi guérit et d'une façon presque miraculeuse. Ce lait fut en grande vogue prendant quelque temps à Paris, où avec la grâce française du seizième siècle, on l'appela "le lait de la vie éternelle".

Pendant des milliers d'années donc les laits fermentés ont été tenus dans l'opinion des anciens comme les plus nutritifs et les plus hygiéniques. C'était l'alimentation des voyageurs au long cours. On s'en servait comme remède, on les recommandait comme moyen de prévenir les épidémies.

Ce fait historique surprenant tout naturellement devait attirer l'attention de la science moderne. Et cette derière, non seulement n'a pas contredit les théories anciennes en cette matière, mais les a au contraire établies scientifiquement en découvrant les phénomènes chimiques et bactériologiques sur lesquels repose la valeur nutritive et médicale des laits fermentés. C'est à un grand savant bactériologiste, Metchnikoff, que l'on doit principalement la découverte scientifique de l'action mystérieuse et bienfaisante de certaines bactéries dans les laits ainsi transformés. Ce grand savant fut directeur de l'Institut Pasteur à Paris et gagnant du Prix Nobel en 1888. Dans ses nombreux ouvrages publiés sur les intoxications intestinales et les causes de la vieillesse, il recommande le lait bulgare, appelé yoghourt, comme le remède tout trouvé pour le traitement de certaines maladies intestinales et comme un élixir doué de la propriété de prolonger la vie. Il attribue à l'usage traditionnel de ce lait—qui empêche la formation des poisons bactériens intestinaux—la longévité bien connue des peuples balkaniques, où les statistiques nous apprennent l'existence d'un centenaire par 1000 habitants alors que dans la plupart des autres pays ou trouve à peu près un centenaire par million d'habitants.

Grâce spécialement aux découvertes de Metchnikoff, la fabrication du yoghourt et du képhyr est sortie des ombres du mystère pour s'établir en pleine lumière; elle s'obtient de nos jours par l'application de procédés bactériologiques bien définis. C'est dire que ces produits laitiers qui étaient essentiellement chez les peuples anciens de fabrication domestique, sont devenus aujourd'hui des produits dont s'emparent de plus en plus la grande industrie et le commerce. Peu connus encore en Amérique, ces produits sont en train d'envahir l'Europe tout entière. Qu'on me permette de citer des chiffres à ce sujet.

A Paris, une vingtaine d'institutions commerciales produisent du yoghourt. La Laiterie Maggi en vend 40,000 bouteilles par jour et la Laiterie Carrion 52,000 par jour selon les derniers comptes-rendus.

A Vienne, la Laiterie "Wiener Melkerei", que j'ai visitée en 1926, produisait 24,000 bouteilles de yoghourt par jour alors que deux autres établissements laitiers de la même ville en vendaient de 18,000 à 22,000 bouteilles par jour.

A Budapest, une seule maison la "Staedtische Melkerei" en vendait en 1927 31,000 bouteilles par jour.

A Zurich, la coopérative laitière de la ville en produit 12,000 bouteilles par jour.

A Berlin, la laiterie "Bolle" on produit en moyenne 60,000 bouteilles par jour.

Le laboratoire de bactériologie du Dr. Axelrod, à Munich, qui prépare les cultures spécifiques pour les laits fermentée et en surveille la fabrication, distribue des cultures à plus de 150 villes d'Europe qui produisent chaque jour une moyenne de 2,000,000 de bouteilles de yoghourt durant l'été et au-delà de 1,500,000 durant l'hiver.

Ces chiffres cités pour la production du yoghourt seulement, suffiront, je pense, à démontrer l'importance que prennent en Europe les laits fermentés, peu connus encore sur le continent américain, à l'exception du lait

acidophylé, populaire aux Etats-Unis. Je ne doute nullement que l'avenir leur réserve ici comme en Europe un puissant développement.

Il existe encore trois types de produits laitiers. Ce sont les laits médicaux, les sous-produits laitiers yoghurés et les boissons lactées.

5.—Les Laits Medicaux

Les laits médicaux, ce sont des laits entiers ou écremés, chimiquement, physiquement ou bactériologiquement préparés de façon à répondre à différentes fins spécifiques médicales, telles par exemple: le traitement du diabète, des néphrites, de l'artério-sclérose, de la dyspepsie et autres maladies. Le lacto-sérum ou petit-lait et le babeurre naturel ou lactique sont aussi rangés dans ces laits médicaux.

Ces laits sont préparés à la demande des hopitaux et des cliniques dans des laboratoires spécialement organisés pour répondre à ces besoins de la médecine et vendus en général sous des noms divers, ayant un rapport avec les maladies à traiter, tels que les laits délactosé pour le diabète, et déchloruré pour les néphrites.

Il y a en Allemagne, en Suisse et en maints autres pays d'Europe différents laboratoires dédiés exclusivement à la fabrication de ces laits médicaux spécifiques et plus d'un sanatorium spécialisé dans les cures lactées.

6.—Les Sous Produits Laitiers Yoghures

Les sous-produits laitiers yoghurés, c'est du yoghourt fait uniquement avec du lait écremé ou du lait de beure, vendu soit en poudre, soit sous forme semi-solide, destiné à l'alimentation des animaux de la ferme, spécialement aux veaux, aux porcs, aux volailles et aux renards.

En plus de leur qualité excessivement nutritive, ces sous-produits laitiers yoghurés, grâce aux ferments lactiques qu'ils contiennent, constituent un préventif de toute première valeur pour quelques maladies, spécialement celles du choléra des poules, de la coccidiose et de plusieurs autres infections bactériennes et parasitaires des animaux de la ferme.

Ces sous-produits yoghurés, bien qu'assez nouveaux encore, se développent assez rapidement en Europe. Ils sont appelés, croyons-nous, à cause de leurs propriétés médicales spéciales, à être de plus en plus recherchés dans l'élevage des volailles, des porcs, des veaux, voire même des renards.

7.—Les Boissons Lactees Rafraichissantes

Les boissons lactées rafraîchissantes sont des breuvages préparés surtout avec du lait écremé, stérilisé en bouteilles fermées, physiquement traités de façon à les conserver indéfiniment dans leur état de solution colloïdale, sucrés, aromatisés et essencés de manière à flatter les goûts les plus raffinés et les odorats les plus délicats.

L'objet de ces laits est de remplacer, partiellement du moins, par une boisson nutritive, saine, rafraîchissante, les breuvages faits uniquement à base d'eau de sucre et d'essence, breuvages que l'on appelle ici "liqueurs douces", qui sont rafraîchissantes, sans doute, mais qui n'ont aucune valeur diétique et qui sont même préjudiciables quand on les consomme en trop forte quantité.

Les boissons lactées rafraîchissantes sont de fabrication relativement facile. Elles se développent très rapidement en Europe et aux Etats-Unis où l'on on rencontre déjà plusieurs types différents, les unes nousseuses et chocolatées, faites uniquement avec du lait écremé, les autres plus riches et plus nutritives, faites avec du lait partiellement écrémé, non mousseuses et parfumées au chocolat, au cacao, a la vanille, à l'ananas, au caramel, etc.

Une maison américaine, avec laquelle je suis en relations, m'informait tout récomment qu'elle en a vendu, dès la première année, plus de 1,000,000 de bouteilles. De tous les produits laitiers nouveaux, ceux qui, à mon sens, devraient le plus rapidement se répandre dans les années qui vont suivre, devraient être ces boissons lactées.

Dans tous les pays, on fait de la propagande par la plume et la parole, l'image et la démonstration, pour une plus grande consommation de lait, en raison de son importance pour la santé. Beaucoup d'hommes, cependant, beaucoup d'enfants, ne peuvent digérer le lait entier; par ailleurs, d'autres, qui le digèrent bien, n'aiment pas cet aliment, qu'ils trouvent d'un goût insipide ou même répugnant; très souvent aussi dans les quartiers pauvres, il arrive que les familles privent leurs enfants de lait entier, à cause de son prix qui n'est pas à la portée de leur bourse trop dégarnie. L'introduction dans un pays des produits laitiers nouveaux que je viens de vous décrire contribuera puissamment à résoudre le problème d'une plus grande consommation de lait, et cela, pour l'amélioration de la santé chez le peuple et le raffermissement économique de l'industrie laitière.

Je ne saurais terminer cette conférence, sans faire ressortir quelques-uns des aspects les plus importants en matière de fabrication beurrière et fromagère. J'ai eu la bonne fortune d'être attaché pendant longtemps à l'une des plus grandes institutions laitières scientifiques d'Europe. J'ai nommé l'Institut de Kiel, en Allemagne, Institut d'où sont sortis quelques-uns des plus grands spécialistes qui dirigent actuellement, ici et là, sur le continent européen et sur le continent américain, la production beurrière et fromagère. La pensée qui dominait alors et qui domine encore tout l'enseignement technique, est d'arriver par les méthodes les plus scientifiques à la production d'un beurre et d'un type de fromage qui puissent défier toute concurrence sur les marchés étrangers. Le grand objectif des pays en concurrence, spécialement le Danemark, la Suisse, la Hollande, l'Allemagne, le Pays scandinaves, la France, l'Italie, est d'arriver à faire un beurre et des fromages de saveur superfine, de goût noble, de qualité uniforme et en plus capables de se conserver longtemps. Depuis le Docteur Storch, directeur de la célèbre institution laitière royale du Danemark, de réputation mondiale, et depuis le Docteur Weigmann, mon professeur, directeur de l'institution de Kiel, il est admis qu'en pratique on ne saurait atteindre un objectif aussi élevé sans la pasteurisation et la dégazéification des crêmes et sans le secours de ferments spécifiques, qui apportent aux beurres et aux fromages l'arôme, la saveur, la texture et la maturation recherchés.

Conclusion

Dans l'exposé bien imparfait que je viens de faire sur les aspects nouveaux en industrie laitière, vous avez dû remarquer l'influence prépondé-

rante de la bactériologie. Sans les cultures appropriées, sans les bactéries spéciales dont les noms sont trop indigestes pour être prononcés ici, point de lait maternisé et de yoghourt, point de lait acidophylé et de lait champagnisé, point de produits laitiers yoghurés pour le bétail, point de fromages d'arôme de plus en plus recherché en Amérique, que le Canada a tort d'importer et de ne pas produire au pays, types Camenbert, Gorgonzola, Roquefort, Gruyère, etc., et difficilement du beurre capable de défier la plus forte concurrence sur les marchés mondiaux.

Et ces cultures appropriées et ces bactéries spéciales pour produire les effets désirés doivent être jeunes, fraîches et bien vivantes pour qu'elles conservent leurs caractéristiques spécifiques; c'est-à-dire qu'il est pratiquement impossible comme l'expérience l'a déjà plus d'une fois démontré de les importer de l'étranger. L'un des grands obstacles à la fabrication de produits laitiers de qualité supérieure, tout particulièrement à la fabrication de bons fromages, c'est la teneur du lait en bactéries spécifiques de la mammite infectieuse, maladie qui sévit dans les troupeaux laitiers de tout le Canada, dans la Province de Québec comme ailleurs.

D'après les recherches que nous avons pu faire en cette matière, pendant trois ans, spécialement dans la région de Montréal, grâce à l'aide du Ministère de l'Agriculture de cette province et du Conseil National des Recherches, je me fais un devoir de vous dire que j'estime à 30% au moins le nombre de vaches laitières affectées par cette terrible maladie qui réduit du quart ou du tiers leur production normale. Fort heureusement, la science bactériologique est en mesure aujourd'hui de combattre d'une façon très satisfaisante cette maladie et d'indiquer les moyens à prendre pour la prévenir.

Ces quelques considérations seront suffisantes, je pense, pour vous démontrer le rôle important de la bactériologie en industrie laitière. Dans tous les pays où on lui a fait a fait une place plus grande, il s'en est suivi une intensification dans la consommation du lait et des progrès nouveaux dans l'industrie laitière en général.

RESUME DES ARTICLES PUBLIES EN ANGLAIS DANS CE NUMERO

Etudes Avec les Vitamines A et D sur la Croissance des Poussins. H. S. Gutteridge, Ferme Experimentale Centrale, Ottawa.

Ces études ont été faites à la Ferme Expérimentale Centrale à Ottawa, à Nappan, N.S., et à La Ferme, P.Q. Elles ont démontré qu'1% d'huile de sardine ne permet pas une croissance normale lorsqu'on l'introduit dans une ration manquant par ailleurs de vitamine A. Cette quantité néanmoins produit une croissance normale et prévient le rachitisme lorsqu'on l'a substituée à l'huile de foie de morue dans les rations utilisées dans ces expériences.

La lumière solaire directe, la lampe à vapeur de mercure, l'huile de sardine, l'huile de foie de morue et certains succédanés du verre semblent être également efficaces en ce qui concerne la fourniture de vitamine D, mais la lampe électrique dite à lumière solaire s'est montrée tout à fait inefficace.

Systeme de Classification des Sols pour etre Utilisé sur le Terrain. J. E. Ellis, Université du Manitoba, Winnipeg.

L'auteur discute divers systèmes de classification des sols et en fait ressortir les points faibles. Il décrit un système de classification qui est, légèrement modifié, celui

développé par le Dr. C. C. Nikiforoff de l'Université du Minnesota, autrefois de Petrograd. La division la plus large est la "zone" et comprend les différentes zones mondiales généralement reconnues. Les zones sont divisées en "combinaisons", lesquelles sont basées sur la géographie physique des régions comprises dans les zones. Les combinaisons sont divisées en "associations" basées sur la nature géologique de la roche mère du sol en question. A l'intérieur des associations sont les "associés" déterminés par le milieu local, comme par exemple la quantité de pluie, le drainage, la salinité, etc. Les variations mineures ou les stages de transition entre les associés forment des "phases".

L'auteur suggère que ce système soit accepté comme système étalon dans tout le Canada de façon à unifier les rapports sur les sols des diverses provinces. Ce système est maintenant utilisé au Manitoba.

Enquete Preliminaire sur la Determination du Phosphore Assimilable dans les Sols de la Saskatchewan. J. Mitchell, Université de la Saskatchewan, Saskatoon, Sask.

Utilisant la méthode de Truog, légèrement modifiée, l'auteur étudie la corrélation entre l'augmentation de récolte résultant de la fumure au phosphate et le phosphate assimilable du sol non traité.

L'auteur conclut que lorsque l'assimilabilité du phosphore est au-dessous de 20 par million tel qu'indiqué par sa méthode on peut s'attendre à des augmentations importantes des rendements du blé dans les sols fumés au phosphate. Lorsque l'assimilabilité varie de 20 à 40 par million il est encore probable qu'il y aura augmentation tandis que lorsque l'assimilabilité atteindt de 50 à 60 a umillion il est peu probable qu'il y ait accroissement de récolte.

L'auteur a noté une grande variation dans l'assimilabilité du phosphore des sols de la Saskatchewan.

Etude sur la Reaction a la Lumiere de Certains Organismes Pathogenes. W. A. R. Dillon Weston, Ecole d'Agriculture, Cambridge, Angleterre.

L'auteur discute la réaction d'organismes pathogènes aux lumières de certaines longueurs d'ondes dans les spectres visible et invisible. Il semble que la pigmentation de certaines spores soit une protection adéquate contre les rayons ultra-violets émis par le soleil, mais les mêmes spores sont susceptibles à la lumière blanche visible et aux rayons calorifiques. Des observations faites dans la pratique semblent montrer que les spores non pigmentées ne tolèrent pas la lumière visible.

Quatre ans d'Observation sur la Spilonota Ocellona D. & S. en Nouvelle Ecosse. F. C. Gilliatt, Laboratoire fédéral d'Entomologie, Annapolis Royal, N.S.

L'auteur a étudié certaines phases de la vie et des moeurs de cet insecte qui n'avaient pas été rapportées auparavant. Il est impossible de donner un résumé satisfaisant de ce rapport qui consiste surtout en détails.

Rapports Optimums Entre les Trois Facteurs de Production sur les Fermes a Volailles de la Colombie Britannique. Vladimer N. Snesarev, Université de la Colombie Britannique, Vancouver.

Les rapports optimums apparents entre les capitaux investis dans les différents facteurs de production sont approximativement les mêmes pour les fermes de toutes grandeurs, à savoir 10% pour la terre, 10% pour le travail, 80% pour l'équipment.

Beaucoup de fermes ont une trop grande part de leur capital investi dans la terre. Beaucoup de fermes utilisent une quantité de travail insuffisant. Il ne semble pas que la phase des rendements décroissants ait été atteinte. Il y a eu plus d'insuccès avec les grandes fermes qu'avec les petites.

Il semble qu'on capital de $5,500.00 soit le minimum qui puisse être envisagé.

LIVRES RECUS

Sapinieres, par A. Schaeffer, A. Gazin et A. d'Alverny—Edité par les Presses Universitaires de France, 49 boulevard St. Michael, Paris.

Cet ouvrage est publié par la Société des amis et anciens élèves de l'Ecole Nationale des Eaux et Forêts, de Nancy. Il donne un exposé complet d'une méthode d'aménagement appliquée dans plusieurs forêts. C'est une mise au point, à la fois scientifique et pratique, qui coordonne des travaux antérieurs et en fixe ce qui a résisté à l'épreuve de l'expérience. Le style en est très technique, mais concis. Les courbes abondent. G.M.

CURRENT PUBLICATIONS

47. Making Farms Pay. Cornelius J. Claassen. Published by The Macmillan Company. Price $2.50.

This book carries the sub-title, "A Way Out For Owner and Tenant" and is a narrative of personal experiences in managing one thousand farms in the United States. Mr. Claassen is a leader in the profession of group farm management. His organization, known as "The Farmers' National Company" has a successful record of management covering a period of the past five years. It is interesting to note that the farms managed by this organization are scattered over several States and throughout scores of communities. From the account given, it is apparent that excellent results have been achieved through intelligent management of methods of production, while marketing has been carried out through regular channels. Practically all the farms managed have been tenant farms and in many cases tenants have been so successful that they have been able to purchase the farms which they were building up. Mr. Claassen places strong emphasis on the necessity of having Field Supervisors of great ability. These are apparently the key men in his organization. There is little indication of the repeatedly mentioned 'inferiority complex' developing in the tenants under such a system of group farming and it is stated that five times as many tenants apply to the Company as there are farms to place them on. The farms turned over to the Company to manage are usually owned by absentee landlords, banks, mortgage companies and insurance companies. This volume contains much interesting material for anyone interested in this type of farming.

48. Agricultural Research, 1930. Published by the Royal Agricultural Society of England. Price 1s.

This volume is the sixth of the series started in 1925. It attempts to bridge the gap between the completion of research work on many farming problems and the application of the results in practice. It makes an excellent outline of the research work conducted in the British Isles. The following papers are included in the 1930 volume.

Crops and Plant Breeding	R. G. Stapledon, M. A.
Dairy Husbandry	J. Mackintosh, N.D.A., N.D.D.
Agricultural Economics	C. S. Orwin, M.A.
Agricultural Engineering	S. J. Wright, M.A.
Animal Nutrition	C. Crowther, M.A., Ph.D.
Soils and Fertilisers	Sir E. J. Russell, F.R.S., D.Sc.
Veterinary Science	F. C. Minett, D.Sc., M.R.C.V.S.

49. Hortus. A concise Dictionary of Gardening and General Horticulture. By L. H. Bailey and Ethel Zoe Bailey. The Macmillan Co., New York. Price $10.

This book is mainly valuable for its up-to-date inventory and classification of the plants of the North American Continent, including as it does notes on the cultivation of the majority. As a ready reference book it has been found of value, even in the presence of larger volumes, such as the Encyclopedia of Horticulture.

Its main value to horticulturists and botanists lies in its annotated inventory.

Although chapters exist on such subjects as insects and insecticides, the information is not given in sufficient detail for the practical grower to rely on wholly. The use of such a chapter could be mainly of value to the casual reader seeking for general information. The chapter on graftage and propagation is a little more complete and should prove of value too for reference work.

The short section on Rock Gardening is exceedingly brief and could have been made of some value by appending a few lists of plants suitable to various sites.

Under the heading of soils there is a useful list of plants with their soil acidity requirements.

The book contains 652 pages and is of handy size for a desk reference volume. M.B.D.

50. Nutrition Abstracts and Reviews. Vol. I, Nos. 1 & 2, October 1931. Issued under the direction of The Imperial Agricultural Bureaux Council, The Medical Research Council, and The Reid Library. Annual subscription—21s. net.

This new abstracting journal, mentioned by Dr. J. B. Orr in his lectures at the C.S.T.A. convention, Guelph, 1931, will prove of great value to the animal husbandry industry. Dr. Orr, himself, heads the list of editors. The large group of corresponding editors includes Lt.-Col. J. A. Amyot, C.M.G., Deputy Minister of Health, Ottawa, and Dr. E. S. Archibald, Director, Dominion Experimental Farms, Ottawa. The committee of management includes three outstanding representatives from the three organizations which issue the journal jointly. The table of contents is divided into seven headings, as follows:—

1, Technique. 2, Composition of Food Stuffs. 3, Physiology of Nutrition. 4, Dietetics. 5, Feeding of Animals. 6, Diet in Relation to Health and Disease. 7, Book Reviews.

The editors are reviewing some 450 periodicals and additional periodicals are reviewed by the corresponding editors. The journal begins with literature published in January, 1931, and only in a very few cases does it refer to papers of an earlier date. The journal is published entirely in English and it is understood that it will appear quarterly. Subscriptions may be forwarded direct to the Secretary, H. Crow, Reid Library, Rowett Institute, Aberdeen, Scotland, or may be ordered through the C.S.T.A., Ottawa.

51. Animal Aggregations. By W. C. Allee, Whitman Laboratory of Experimental Zoology, University of Chicago, Chicago, Illinois. U.S.A. Published by The University of Chicago Press, Chicago, Illinois, U.S.A.

This book of 431 pages with the subtitle "A Study in General Sociology"—"may even be designated as notes on an unsolved problem:"—"summarizing our growing knowledge on the subject of animal aggregations." It presents the result of the author's experimental work over a period of from 1911 to date studied in the light of germane work in zoological literature, the whole being in essence a formal progress report upon an investigation into "the relationships existing among the more loosely integrated collections of animals"— "with regard to their ecological and behavioristic physiology as well as with regard to their strictly social implications."

The first five chapters (pg. 1-81) serve as an introduction giving the general background, classification, formation, factors conditioning and integration of animal aggregations. Chapters six to eight (pgs. 101-136) outline the harmful effects of crowding upon growth, reproduction and survival. Chapters nine to sixteen (pgs. 147-263) continue the discussion, in terms of the beneficial effects of crowding both in the life activities of the animals themselves and in their interaction with the environment. Chapters seventeen and eighteen (pgs. 289-311) treat of general effects of crowding as upon sex determination and morphology. The two last chapters (pgs. 337-362) gather up the several lines of thought in the book indicating their possible importance in social evolution in its broadest sense and presenting the idea "that aggregations formed without sexual stimuli and at the lowest level of group integration may have survival value for their members and under certain conditions are essential for the survival of the race."

The work is rounded out with an excellent bibliography of 44 pages and an index which is a very joy in its completeness. H.G.C.

52. Proceedings of the Fifth Annual Meeting of the Western Canada Society of Animal Production, University of Saskatchewan, Saskatoon, Sask., July 23-24, 1931. 61 pages, mimeographed. Available on loan from the Department of Agriculture Library, Ottawa, Canada.

This report, of interest to animal husbandmen and extension workers, contains the following material in addition to minutes, resolutions, etc.

Report of Poultry Committee—Prof. R. K. Baker.
A Study of Leg-Bone Deformities in Growing Chicks—Prof. M. Herner.
Report of Swine Committee—R. M. Hopper.
Report of Sheep Committee—E. Van Nice.
Methods of Investigations—Prof. G. W. Wood.
Report of Committee on Methods of Extension.
Report of Dairy Cattle Committee:

(1) Survey of Experimental Work—Prof. J. P. Sackville.
(2) The Status of the Sweet Clover Disease Problem—Prof. J. M. Brown.
(3) Raising Dairy Calves—A. H. O. Colbert.

Report of Special Committee on Mineral Deficiencies—Dr. S. E. Clarke.
Report of Special Committee on Beef Cattle Standards—L. B. Thomson.
Report of Beef Cattle Committee. L. B. Thomson.
The Need for Pasture Research in Relation to Reducing Production Costs on the Farm—M. J. Tinline.
Report of Horse Committee—Prof. H. B. Sommerfeld.

53. Report of Proceedings of the Third Annual General Meeting of the Eastern Canada Society of Animal Production, Ontario Agricultural College, Guelph, June 23-24, 1931.

This report, similar in style to the report of the Western Society, contains the following material of special interest,—

The Development of our Knowledge of Nutrition—Dr. J. B. Orr.
Faulty Diet as a Factor in Disease—Dr. J. B. Orr.
Results of Pasture Improvement Investigations in Eastern Canada—C. F. Bailey.
Animal Husbandry Progress—Dean H. Barton.
Genital Diseases—Dr. R. L. Conklin.

54. Land Utilization in a Southeastern Ohio County, Ohio Agricultural Experiment Station Bulletin 485, by J. H. Sitterly, H. R. Moore and J. I. Falconer.

"Marginal land areas have attracted much attention in recent years. The prevailing relatively low prices of farm products for the past ten years have led to a reduced income to those engaged in agriculture, especially those farmers located on less productive lands. Many regions which were settled in the days of hand tools have found it increasingly difficult to compete in these later years of large units of machinery and the gas engine areas which could provide a satisfactory living in the era of few wants have found it difficult to provide a satisfactory living in the days of good roads, automobiles, radios, telephones, etc. All items which cost money. Marginal lands have therefore come in for their share of attention in the discussion of solutions of the agricultural problems."

The authors conclude, "In view of the apparently inevitable and perhaps advisable decline in population, any distribution of public funds for roads and schools in such areas should be interpreted as temporary and planned accordingly. The present and future use of these idle lands and abandoned areas may well be considered in any state conservation and forestry program." J.C.

INTERNATIONAL CONGRESS OF GENETICS

Over five hundred members have already enrolled for the Sixth International Congress of Genetics to be held at Ithaca, New York, August 24-31, 1932. Many of those enrolling have done so recently. Because of the past uncertainty of holding the Congress, it seems probable that there are many other individuals who, now that it has been definitely decided to go ahead, will wish to join as soon as possible. For this reason the Council has decided to extend the date for ten dollar memberships until May 1, 1932. After that date the memberships will be at an increased fee, twelve dollars. Graduate students and assistants may join as six dollar members until May 1, 1932. After that date their memberships will be at the rate of seven dollars. Both of these revisions have been made because of the exceptional economic conditions and because the Council is anxious, in so far as it is possible, to avoid having financial considerations a deterrent to memberships. The number of people who have already joined insures a representative and highly successful Congress, and reveals as well the great amount of active interest in genetics at the present time. The guarantee that proceedings will be published and that each member will receive a copy, has proven to be a strong attraction, not only to geneticists but to many biologists in other fields.

CONCERNING THE C.S.T.A.

AMALGAMATION OF C.S.T.A. COMMITTEES

At the 1931 C.S.T.A. Convention at Guelph a resolution was adopted to the effect that the incoming Executive be asked to consider the matter of re-organization of the various standing committees, with particular reference to the amalgamation of the Committee on Educational Policies with the Committee on Agricultural Policies and the possibility of a Committee on Extension. This matter was discussed by the Directors at their annual meeting in December and the Executive was empowered to form one new committee to carry on the work of the two former committees. This has been done, and the new committee is to be designated as the "C.S.T.A. Committee on Education and Extension." The function of the committee will be to report on the following:—

(1) Education: (a) Courses and methods in universities and colleges.
(b) Co-ordination of university and college policies.

(2) Extension: (a) The application of educational methods to extension work.
(b) The co-ordination of extension and administration policies.

It is suggested that, as this Society year is half over, the committee should not attempt to present definite findings in these fields but that it should ask the Executives of the Locals to suggest certain situations requiring special study. A full year's study may then be undertaken on these next year. The committee, itself, may also recommend any subjects it sees fit. The Executive thinks it strongly advisable for committees to recommend certain problems for study to the Locals. In this way we will be able to build up a strong body of opinion which will be back of recommendations made by standing committees of the Society.

In view of the fact that the chairman of both the former committees have been western men for a number of years, it was suggested that the chairman of the amalgamated committee be an eastern man. To avoid all appearance of favouritism to any province or section of opinion, it was felt best to ask one of the Vice-Presidents of the Society to act as chairman and accordingly the following committee has been appointed:

Dr. G. I. Christie, Guelph, Chairman.
Dean A. M. Shaw, Saskatoon.
Dr. W. J. Black, Montreal
Dr. L. P. Roy, Quebec.
Mr. R. S. Duncan, Toronto.

It will be noted that the function of the committee is to report on matters covering several fields. Previous experience with committees assigned to report on these fields separately has shown that instruction in the universities, methods of extension, and the co-ordination of administration and extension policies overlap one another to such an extent that it is difficult to restrict separate committees to their separate fields. It is felt that one committee only will be better able to advise the Society on the co-ordination of opinion in these various fields.

The Committee on Education and Extension, and the Committee on Research will thus be the two main study committees reporting at conventions. As the work of the Committee on Economics and Marketing is very closely allied with the work of the Canadian Society of Agricultural Economics, this committee will no longer exist and the Economics Society will be asked to sponsor any resolutions on these subjects to be brought before the C.S.T.A. By reducing the number of standing committees reporting at Conventions, it is hoped that more time will be available for discussion of the reports presented.

The members of the committee are asked to get in touch with the Executives of the following Locals:

Dean A. M. Shaw,
Manitoba
North Saskatchewan
South Saskatchewan
North Alberta
South Alberta
British Columbia

Dr. L. P. Roy
Northern Quebec and Ontario
Montreal District
Quebec Eastern Townships
Quebec City
Ste. Anne de la Pocatière

Mr. R. S. Duncan,
Western Ontario
O. A. C.
Eastern Ontario
North-Western Ontario
Niagara Peninsula

Dr. W. J. Black,
Macdonald College
Montreal City
New Brunswick
Nova Scotia
Prince Edward Island

Executives of Locals are urged to respond to the invitation of these members to present suggestions to the Committee on Education and Extension.

NOTES AND NEWS

C. B. Twigg (Toronto, 1907) has moved from Creston, B.C. to Cranbrook, B.C.

Walter Jones (California, 1929) has returned from his home in Wales to his work at the Dominion Laboratory of Plant Pathology, Saanichton, B.C.

Thomas Kilduff (Alberta, 1929) has changed his address from University of Alberta, Edmonton, to Lloydminster, Alberta.

C. H. Lavoie (Laval, 1924) formerly agronome at St. Casimir, Portneuf, P.Q., is now Instructor in the Rural Economic Service, Parliament Bldg., Quebec, P.Q.

Ernest Giasson (Montreal, 1925) has changed his address from Agricultural School, Ste. Anne de la Pocatière to 245 Bouthillier St., St. Jean, P.Q.

A. St. Pierre (Laval, 1922) is now located at the Dairy School at St. Hyacinthe, P.Q., where he holds the position of General Secretary to the Breeders of the Province of Quebec.

E. Léopold Raynauld (Montreal, 1920) formerly Assistant Registrar of the Experimental Station at Ste. Anne de la Pocatière, is now Agronome for the County of Soulange and is located at Côteau du Lac, P.Q.

H. L. Berard (Montreal, 1926) has been appointed Bacteriologist of the Provincial Dairy School at St. Hyacinthe, P.Q.

G. E. Michaud (Laval, 1919) Inspector in the Junior Farmer Section of the Horticultural Service, Province of Quebec, has changed his address to 45 Avenue Lévis, Quebec, P.Q.

Howard W. Mead (Saskatchewan, 1926) Assistant Plant Pathologist at the Dominion Laboratory of Plant Pathology, Saskatoon, Sask., was married on December 24 to Miss Norma Dearing of Saskatoon.

C. Shirriff (Manitoba, 1929) has changed his address to 11,218—126 Street, Edmonton, Alberta.

James Marshall (Washington State, 1929) Assistant Entomologist, Dominion Entomological Laboratory, Annapolis Royal, Nova Scotia, is now at Macdonald College, P.Q.

P. H. Ferguson (Toronto, 1920) has changed his address to 16 Royal Crest Apartments, Wellington Crescent, Winnipeg, Man.

J. C. Magnan (Montreal, 1912) Director of Junior Farmers' Section, Horticultural Service, Department of Agriculture, Quebec, P.Q., has changed his address to 13 Avenue Désy, Quebec, P.Q.

W. L. Kerr (Toronto, 1915) has been appointed Experimental Farm Assistant at the Experimental Station, Rosthern, Sask.

P. O. Ripley (Toronto, 1922) has been promoted from the position of Experimental Farm Assistant at Lennoxville, P.Q., to Chief Assistant, Division of Field Husbandry, Central Experimental Farm, Ottawa.

NEW MEMBERS

The following applications for regular membership have been received since November 1st:

Raymond Langlois (Montreal 1922, B.S.A.), Lambton, P.Q.

Ubald Pilon (Laval 1931, B.S.A.), Amos, P.Q.

J. A. Marcoux (Laval 1921, B.S.A.), Lennoxville, P.Q.

R. M. Lewis (Toronto 1921, B.S.A.), Ithaca, N.Y.

R. K. Bennett (McGill 1927, B.S.A.), Dominion Live Stock Branch, 316 Bridge St., Montreal, P.Q.

Geo. Gauthier (Laval 1930, B.S.A.) Ste. Anne de la Pocatière, P.Q.

Raymond Trueman (Mt. Allison, 1931, B.A.), Ithaca, N.Y.

J. K. Mackenzie (Saskatchewan 1918, B.S.A.), Winnipeg, Man.

The following applications for student membership have also been received:

University of British Columbia,

F. A. Oldfield.

Ontario Agricultural College, Guelph.

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Eugene Godbout.
Vincent Lanouette.
Francois Levesque.
Premelite Robichaud.
P. E. Bernier.
P. Emile Begin
Lucien Lavalee.

ERRATA

In the November, 1931, issue of "Scientific Agriculture" (Vol. XII No. 3) in the article by K. W. Neatby entitled, "Factor relations in wheat for resistance to groups of physiologic forms of *Puccinia graminis tritici*", the heading of table 19 on page 150 which now reads, "*the cross Marquis* × *H-44-24.*" should read "*the cross Marquillo* × *H-44-24.*"

In the November, 1931, issue of "Scientific Agriculture" (Vol. XII No. 3) in the article by R. F. Peterson entitled, "Stomatal behavior in relation to the breeding of wheat for resistance to stem rust" the caption under Figure 1, page 158, which now reads "Left to right" should read "Right to left."

In the January, 1932, issue of "Scientific Agriculture" (Vol. XII No. 5) in the article by A. J. G. Maw and W. A. Maw entitled, "A method of estimating the mean annual egg weight", the following corrections should be made in the tables on pages 284 and 285: Table 5.—in the column for the tenth month the sixth item from the top which now reads, "50.11" should read, "60.11." Table 6.—in the last column, the fifth item from the top which now reads, ".13±0.515" should read, ".87±0.515".

In the January 1932 issue of "Scientific Agriculture" (Vol. XII, No. 5) in the article by J. B. Harrington entitled, "Varietal mixture in commercial wheat and its effect on milling and baking quality" the second line (Country Elevator to Ocean Cargo) in the tabulation below the middle of page 277 which now reads "0.64%" in the middle column should read "—0.64%".

SOCIETE DE EXPERTISE AGRICOLE

The above Société, which was mentioned a few months ago in "Scientific Agriculture" has published an interesting "Handbook for the Farmers of the Province of Quebec". It carries a foreword by Premier L.-A. Taschereau and an introduction by the Hon. A. Godbout, the Minister of Agriculture. Brief articles are included by the heads of the various branches of the provincial Department of Agriculture and by leaders in provincial educational institutions and industrial organizations. The work of the federal Department of Agriculture is described by the Hon. Robert Weir.

The Société, under the direction of Mr. Robert Raynauld, is performing a valuable service in those fields which lie outside the legitimate sphere of government activity, such as the evaluation of farms subject to expropriation, evaluation of damages by flood and fire, technical agricultural advice to municipalities on engineering, and general publicity and translation for commercial firms. Copies of the handbook are available for free distribution from the offices of the Société at 1010 East St. Catherine Street, Montreal.